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CHEMICAL AGE

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ENERGY TO ELECTRICITY

RESEARCH on fuel cells is being sponsored by the Ministry of Power, with the aim of developing primary batteries to convert the chemical energy of fuel directly into electrical energy without employing a heat engine. Both in the U.K. and the U.S., fuel cells have been developed which employ as the chemical reaction the oxidation of fuel to carbon dioxide and water (see CHEMICAL AGE, 19 July, p. 106, and 1 November, 722). Virtue of the fuel cell lies in the fact that it has no such limitations as those where power producing plant is used and where by purely theoretical considerations, the thermal efficiency is of the order of 38% or 40%.

Another important aspect of converting chemical energy of gases into electricity is that it could be a cheap source of hydrogen. The U.S. National Carbon Co's. fuel cell, for instance, works by hydrogen and oxygen units uniting to form water (water electrolysis in reverse). To compete with conventional power systems, however, hydrogen would have to be easier and cheaper to obtain than at present. Suitable sources of hydrogen would be coal, from which hydrogen can be obtained by steam treatment; ammonia, which is generally plentiful; petroleum; and solar energy, used to decompose water whereby both hydrogen and oxygen are obtained. Hydrides, such as lithium hydride which contains a lot of hydrogen, are a possibility, as is hydrazine which can be decomposed at room temperature.

Latest news on fuel cells comes from Allis-Chalmers of the U.S. who have developed a hydrogen-oxygen cell which is claimed to have the highest voltage-to-volume ratio yet achieved in this 150-year-old quest for economical means of converting chemical energy direct to electricity.

The new Allis-Chalmers fuel cell is described as a metal box 10 in. long, 4 in. wide and 8 in. deep, which is divided into 24 individual, series-linked cells by flat metal electrodes immersed in potassium hydroxide electrolyte. The unit is stated to deliver 24 volts when operating at room conditions and to be able to light up two 15 W bulbs.

Main difference between the new cell and the hydrogen-oxygen cell developed by National Carbon Co., a division of Union Carbide Corporation, is that the latter uses hollow graphite electrodes with a catalyst coating. Allis-Chalmers use a catalyst coating for the electrodes and have reported that among others platinum black has proved successful.

Details regarding the efficiency of the new cell, which is said to be still a laboratory device, have not been given. Nevertheless, Allis-Chalmers researchers on the project believe that it will ultimately operate with 80% fuel efficiency and be able to deliver something over 1kW/cu. ft. (similar figures have been quoted for National Carbon's fuel cell, which is being used by the U.S. Army to power portable radar sets).

At the same time, another type of fuel cell—the hydrocarbon cell—has been reported by Esso Research and Engineering Division, U.S. It is described by Esso as an ethane-air cell. No technical details have yet been released, but the cell is understood to be still a laboratory model. The power

output is stated to be only in the flashlight-bulb range.

Hopes for practical direct heat-to-electricity conversion are also rising, for Los Alamos Scientific Laboratory, Los Alamos, U.S., have devised a plasma thermocouple. The device appears to bear some resemblance to the thermionic converter announced by General Electric, U.S., a year ago. A gas plasma with a metal electrode is used as against the conventional metal-metal approach. Theoretical maximim efficiency is stated to be better than 30%. Conversion efficiencies obtained to date are of the order of 2-5%.

Plasma is generated when heat from the heat source ionises caesium vapour in a cell at a pressure of from 0.1 mm. to 2 mm. mercury. Use is made of caesium since it vaporises at a low temperature (670° C) and, even more important, because it has the lowest ionisation potential (3.88 volts) of any element. However, rubidium, potassium, sodium and lithium could be used. The electrode is tantallum, although again other metals can be used.

Voltages of 2 volts have already been obtained by the Los Alamos scientists in small-scale experiments and plans are in hand to use nuclear reactors as a source of heat in future tests.

Latest in electrochemical cells is that developed by Lockheed Missile Systems. Two components of the fuel which is not known are circulated through the cell. Again electrochemical reaction converts chemical energy directly to electrical energy. A fuel utilisation of almost 100% is claimed. Research worker at Lockheed, Morris Eisenberg, predicts that such a cell with enough energy to power a car or plane could be developed in five years.

At the University of California, a solar battery has been produced from organic materials. Organic dyes (such as the oxidised form of tetra methyl-*p*-phenylene diamine and magnesium phthalocyamine) are pressed into wafers. Sunshine falling on the laminated unit has been found to cause a small current to flow. As there are a great number of semi-conducting organic dyes available, it is believed that the present low output of energy may be bettered. Solar batteries of this type could prove to be very much cheaper than previous silicon solar batteries.

POLYPROPYLENE CLAIMS

THE current patent situation with respect to polypropylene developed by the Montecatini Company of Italy and the working relationship between Professor Karl Ziegler, of the Max Planck Institute, Mulheim-Ruhr, Germany, and that company with respect to those patents are causing concern. Considerable publicity is being given to the matter by Dr. Bartolomeo Orsoni, head of Montecatini's new projects and developments. Dr. Orsoni stresses that Montecatini is the exclusive owner and controls the licensing all over the world of the patents and patent applications on Professor Giulio Natta's sterically differentiated polypropylenes and stereospecific propylene polymerisation processes. The only exception is Germany, where Montecatini have granted exclusive rights to Professor Ziegler.

Orsoni says that the developments of Ziegler in the higher olefin polymer field are subsequent to Montecatini's basic inventions in polypropylene and other higher olefins. Also, that the later Ziegler developments in the higher olefin field relate only to a process which yields polymerisates of practically no commercial interest.

Ziegler has licensed Hoechst in Germany to manufacture polypropylene and in turn, says Orsoni, Hoechst have sold their know-how to Hercules Powder Co., in the U.S. Hercules are, of course, now manufacturing polypropylene in the U.S. without any license agreement with Montecatini. Hoechst do not have any rights under Montecatini's patents to sub-license any company in the U.S., reports Orsoni. In the meantime basic patent applications on Natta's polypropylene developments are still pending in the U.S. Patent Office.

Montecatini's 'Moplen' polypropylenes are currently being marketed in the U.S. by Chemore Corporation, New York. They are available as a plastic moulding resin and will soon be available as special staple fibres.

Rejecting these claims by Montecatini, Hercules report that they have not sought or obtained a sub-license from Hoechst under any Montecatini patents on polypropylene. The company states that it has developed its own process of manufacturing and that Hoechst have shared in its development. This development was not based upon any Montecatini patent or know-how.

Hercules are not the only company in the U.S. interested in polypropylene. Of the four other interested producers, there are Esso Research and Engineering (Standard Oil of New Jersey) who have their own, as yet undisclosed, process, for which Humble Oil and Refining is proceeding with a large-scale commercial plant. Among the remaining interested companies are Eastman, Dow and Monsanto (see CHEMICAL AGE, 13 September, p. 436).

Celanese Corporation are now going ahead with developments based on their own research findings on polypropylene. They have no arrangements with Montecatini. Polypropylene is also under investigation by Standard Oil of Indiana, in their own research unit. No comment has been made on their plans for commercial production.

From the patent claims made by Montecatini, it seems obvious that the Italian company is disturbed by the headway made by U.S. companies in developing polypropylene. It will be recalled that Montecatini were proposing to set up a plant in the U.S. to produce the plastics, and a site for this was under consideration. Recently, the company announced that their Ferrara polypropylene installation was to expand to almost three times its size with a production capacity of 20,000 tons and a projected potential of 30,000 tons (CHEMICAL AGE, 8 November, p. 765).

NEW SYNTHESIS FOR KHELLIN

SEVERAL syntheses of khellin, a furano-chromone derivative employed for its specific coronary vasodilatory activity, have been recorded. None, however, has proved to be suitable for economic production of khellin. Now, from the department of chemistry at Delhi University, Delhi, R. Aneja, S. K. Mukerjee and T. S. Seshadri, report that a new synthesis has been achieved which appears to be more promising. (*J. Sci. Industr. Res.*, 1958, **17B**, 382.) The furan ring has been built following these workers' ideas of the biogenesis of this ring in natural products. An *o*-hydroxy-phenylacetaldehyde system was suggested as the immediate precursor which gave rise to the furan ring by cyclo-dehydration. The acetaldehyde residue itself is considered to arise by the oxidative fission of a dimethylallyl group via the corresponding epoxy-*iso*-pentanyl and *iso*-pentane-2:3-diol structures. For laboratory syntheses following this route, use of allyl group in place of the dimethyallyl group and fission of the allyl bond in one stage by ozonolysis are reported as convenient.

Brief experimental details reported by Aneja *et al.*, show that the 2-tosyloxy-3:6-dimethoxy-4-hydroxy-5-allyl-acetophenone (II) obtained by the Claisen re-arrangement of 2-tosyloxy-3:6-dimethoxy-4-allyloxy acetophenone (I) was subjected to ozonolysis in formic acid solution. Cyclo-dehydration of the resulting crude 2-hydroxy-3:6-dimethoxy-4-tosyloxy-5-acetyl phenylacetaldehyde (III) by means of polyphosphoric acid yielded 2-O-tosylkhellinone (IV). Hydrolysis by dilute potassium hydroxide gave khellinone (V) which was converted into khellin by condensation with ethyl acetate as described earlier. Overall yield of khellin from 2:4-dihydroxy-3:6-dimethoxy acetophenone was about 30 per cent. Further details on this synthesis of khellin are to be published.

ESSO'S £10 m. PROJECT INAUGURATED

The Esso butadiene plant. Foreground is the butadiene extraction unit while the tall central tower is part of the dimerisation unit. In the background is part of the butene dehydrogenation plant

New Ethylene and Butadiene Facilities at Fawley Refinery

ETHYLENE plant with a capacity of 40,000 tons a year and a butadiene unit with an annual capacity of 42,000 tons were inaugurated at the Esso Petroleum Co. Ltd. Fawley refinery last week by Lord Mills, Minister of Power. The ethylene plant utilises a steam-cracking process, while butadiene is produced by the Esso dehydrogenation process.

This major addition to U.K. petrochemical facilities represents a new phase in Esso operations, for previously their chemicals plant has been confined to the production of very high purity sulphur (28,000 tons a year, for customers in the London area) and heptenes (15,000 tons a year, supplied to I.C.I. for conversion to higher alcohols (plasticisers)).

The new chemical facilities have been built at a cost of about £10 million. Total cost of the refinery to date, including chemical plants, has been £68 million. The combined chemical plants utilise a little over 1% of the Fawley crude oil throughput of 10 million tons a year.

Supplies By Pipeline

The ethylene plant has been built to supply 11,000 tons a year of ethylene gas by pipeline to the nearby Monsanto Chemicals polythene plant (due on stream shortly) and 18,000 tons a year to the nearby ethylene oxide and glycol plant being built for Union Carbide Ltd. (due for completion by the end of 1959). Because neither company is yet taking supplies, production is limited to about 50 tons a day which is being sent in the liquid form by road tanker to other customers including I.C.I. and the Ethyl Corporation. The difference between the Esso capacity of 40,000 tons and the eventual 29,000 tons to be taken by Monsanto and Union Carbide will go to other customers.

The steam cracker and the ethylene unit have been on stream for nearly four weeks producing, in addition to ethylene, a secondary butadiene stream at the rate of 8,000 tons a year. The main butadiene plant is about to be started up. Butadiene will be supplied to the neighbouring plant of International Synthetic Rubber Co. Ltd., which came on stream earlier this year.

Total area covered by the new chemicals project exceeds 600,000 sq. ft. In terms of major items of equipment, there are 31 towers, 203 vessels of various sizes, 260 heat exchangers, 168 pumps, 18 compressors, seven furnaces and more than 100 miles of process piping. The plant was designed by Esso Research and Engineering and built by the main contractors, Foster-Wheeler.

The steam cracking process was chosen for the production of ethylene because it produces a variety of valuable by-products in addition to ethylene. The process has been largely developed by Esso's U.S. affiliated research company, and the products include propylene, butadiene, isobutylene, normal butylene, pentylenes and cyclopentadiene.

Virgin Naphtha Feedstock

Feedstock is based on 6,000 barrels a day of virgin naphtha, which accounts for about 0.05% of the crude throughput. Pentanes and lighter materials are removed from the light naphtha stream as the overheads in a single fractionating tower and the bottoms are pumped as feed to the steam cracker furnaces.

Steam Cracking: The furnaces are designed to provide a very high heat density in the radiant section. The hydrocarbon charge is mixed with steam and passed through a normal convection section where it is vaporised and heated to about 1,200°F. After leaving the convection section it passes rapidly through a series of tubes in the centre of the furnace in which the actual cracking takes place.

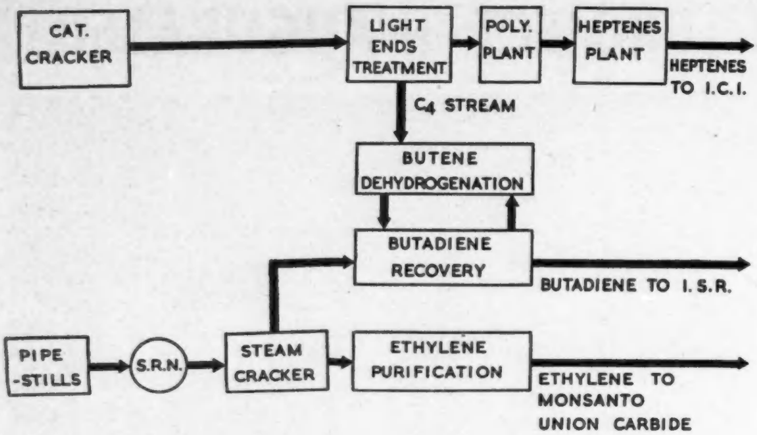
The presence of steam reduces the hydrocarbon partial pressure which favours the production of olefins and di-olefins. The material leaving the furnace is rapidly quenched by the introduction of a heavier oil, which is vaporised in the process. The short residence time at high temperatures reduces the tendency of the cracked hydrocarbons to polymerise.

Cooled products pass to a quench tower, where they are further cooled, separated from the quench oil, and passed to a centrifugal compressor before the next stage of separation. The quench oil bottoms contain excess heat which is used to raise steam in a waste-heat boiler and to provide feed preheat and reboiler heat to the depentaniser unit. Other streams from the quench oil system are used in the other units which are described below.

Product Separation: The liquid and vapour streams from the compressor are separately caustic-washed and passed to an absorber de-ethaniser tower, where ethane and lighter components are split off and sent to the ethylene recovery unit. The absorber de-ethaniser bottoms are fed to a debutaniser tower, and the bottoms from the debutaniser provide a naphtha stream for clay treating. The feed and the lean oil to the de-ethaniser, together with three 'pump-around' side-streams, are subjected to propylene refrigeration to reduce the temperature of the tower.

Debutaniser overhead product forms the feed to a depropaniser tower where separation between C_3's and C_4's is achieved. Propylene is the principal overhead product which is present in quite large volumes and currently goes into the gasoline polymer plant for conversion into high octane gasoline. The C_4 stream passes to butadiene extraction unit.

Clay Treating: The naphtha stream



Simplified flow sheet of the Fawley chemical plants

for clay treating is heated by a quench oil 'pump-around' stream, before passing through a clay bed. The clay treatment serves to polymerise di-olefins and some olefins, which otherwise would act as gum-forming components in the gasoline. A re-run tower following the clay treatment separates the polymer from the naphtha. The naphtha is caustic-washed, treated with inhibitor and sent to gasoline blending. Among possible uses for the polymer are as a core oil and in resin.

Purification and Recovery: Low temperature fractionation is to be used to separate the ethylene from the C_2's and lighter components in the feed for the ethylene recovery unit. Compared with low temperature absorption processes, it has the disadvantage of requiring lower temperatures and hence a heavier refrigeration duty, but it alone can produce ethylene of the required purity.

Acetylene is among the impurities for which a low concentration is essential to polythene manufacture, and it is planned to remove acetylene by selective hydrogenation over a catalyst. Steam is mixed with the feed to the hydrogenation reactors to assist in control of the reaction. Hydrogen is present in excess with respect to the acetylene, and the conditions of temperature and pressure are chosen to achieve highly selective hydrogenation of the acetylene without simultaneously converting ethylene to ethane.

After hydrogenation, the gases are compressed, dried and cooled by passage through a series of heat exchangers, including propylene and ethylene-refrigerated coolers, before entering a demethaniser tower. Here, methane, hydrogen and a small amount of C_2's go overhead at a temperature below $-100°F$. The overhead product is cooled and partially condensed to provide reflux. The non-condensed overheads are expanded into a Joule-Thomson flash drum. The very low temperatures thus obtained provide further liquefaction, and the liquefied material is recycled to recover its ethylene content.

The bottoms from the demethaniser tower provide the feed for an ethylene-ethane splitter tower. Because of the small difference in the relative volatiles of ethylene and ethane, this tower contains 80 trays and is the tallest on the entire chemicals project. The trays are of the jet type to a design patented by Esso Research. The bottoms product is almost entirely ethane, and goes to fuel gas. The overhead product is partially condensed by propylene refrigeration, and is supplied either as liquid or gaseous ethylene of very high purity.

Butadiene by Esso Dehydrogenation

FOR the production of butadiene, the availability of C_4 hydrocarbons in the refinery dictated the choice of a dehydrogenation process and the Esso process was adopted in preference to the Houdry method. The Houdry process utilises n-butane, the Esso process takes n-butylene. Given the same starting price for each material, Esso believe that their process is the most economic.

Feed Preparation: Main feed for the butadiene unit is a C_3/C_4 stream from the catalytic cracker; this initially contains little, if any, butadiene. Additional butadiene is recovered from a C_4 stream from the steam cracker, which is relatively rich in butadiene and follows a slightly different cycle of treatment.

The main catalytic cracker stream passes through a depropaniser tower and a debutaniser tower which are sited in the light-ends plant. The product from the bottom of the second tower consists of mixed butane, isobutylene and butenes. These pass to an isobutylene extraction unit on the butadiene plant.

The unit comprises two extraction stages in series, with counter-current flow of hydrocarbon and 65% sulphuric acid. The isobutylene dissolves in the acid, and the final acid extract passes to a dimer heater. Here the isobutylene is dimerised and the acid regenerated. Acid is separated from the dimer product in a settling drum, and the spent butenes and the dimer pass through a caustic wash to the dimer re-run tower. This is a single-stage fractionating unit which removes C_5's and heavier hydrocarbons from its feed. The bottoms go to storage, while the overhead product constitutes the feed to butene dehydrogenation unit.

Butene Dehydrogenation: The feed, consisting principally of normal butenes, passes through a furnace where it is preheated. On leaving the furnace, it meets superheated steam which has been preheated in another furnace and the mixture passes through a catalyst bed at about atmospheric pressure. Two reactors are provided, one on stream and one regenerating, the time for a complete cycle being about 30 minutes. Regeneration is performed with a mixture of steam and air.

The product from the dehydrogenation process is a rather dilute butadiene stream which requires cooling, compressing and fractionating before it is passed to the butadiene extraction unit. The final stage of the cooling process before compression employs an extensive Head Wrightson air fin cooler. This novel form of condenser in which air is used as the cooling medium instead of the usual water, reduces pollution problems, is cheaper and requires less maintenance. Air is blown by fans between banks of finned tubes inside which the butadiene stream is cooled to liquid form.

Butadiene Extraction: Both the butadiene-containing stream from the steam-cracker lights ends and that from the dehydrogenation process are subjected to butadiene extraction in parallel units. This stage is the first treatment which the steam-cracked C_4 stream receives on the butadiene production plant.

Each butadiene extraction unit consists of an acetylene extraction stage followed by a butadiene extraction stage. Solutions of cuprous ammonium acetate (CAA) are used in both cases for the extraction process, under different conditions of refrigeration in mixer-settler trains. The last four mixer-settler stages of the butadiene extraction are common to the two trains. Propylene is used as the refrigerant, and is compressed in a gas-turbine driven centrifugal compressor.

Butadiene Recovery: Butadiene is stripped from the rich CAA solution in a desorber tower, after which the CAA solution is cooled, char-treated to remove acetylene polymers and returned to the system to be used again. After water-washing to remove trace quantities of ammonia, the butadiene product is finally re-run in a single fractionating tower, condensed overhead using propylene refrigeration, and sent to storage in spheres. It is delivered to I.S.R. by pipeline as a liquid, at a purity of 98.5%.

Spent Butenes: The spent butenes from the steam-cracked mixer-settler train pass to an isobutylene extraction unit similar and parallel to that already described for the catalytic cracked C_4's feed. The normal butenes from this unit are fed to the dimer re-run tower, as also is a part of the spent butenes recycled from the catalytic cracked mixer-settler train; the remainder is returned to the refinery where it is polymerised to petrol.

NITROGEN OUTPUT STILL EXCEEDS CONSUMPTION

Prices May be Raised or Production Cut

THE general outlook for nitrogen is not pessimistic and if the necessary co-operation among producers takes place, the temporary estimated surplus should not unduly disturb the market. This is stated in the December half-yearly report of Aikman (London) Ltd.

Since the June report (see 'Chemical Age,' 22 November, p. 847) the situation in the world nitrogen market has continued to develop on similar lines, both in regard to production and consumption.

Production exceeded consumption in 1955-56 by about 468,000 metric tons of pure nitrogen; in 1956-57 by about 179,000 tons and in 1957-58 by about 225,000 tons. Estimates for 1958-59 show that production will exceed consumption by about 595,000 tons. As the total figures continue to rise, however, the percentage difference between production and consumption, except that for 1958-59, is stated to be 'not formidable.'

Stocks in Europe at 30 June 1958 were estimated at under 300,000 tons or about 6% of production, 'not an alarming figure,' and were represented largely, state Aikman, by ammonium nitrate, particularly 20½% and urea.

In the next largest producing markets, the U.S. and Canada, stocks are reported as being more or less normal. The two largest producers the U.S. and Europe, have tended to reduce production because of low prices. This trend is likely to continue next year and it is therefore possible that the estimated surplus may be considerably less than present figures indicate.

It is believed that U.S. producers are only working to about 75% of capacity and in Germany, France, Belgium and Italy, the largest producers at probably not more than 80% of capacity. Production of ammonium sulphate, the material in which major reductions have taken place owing to the high cost, is more or less in balance with usage.

In the home market, Government subsidies for the U.K. and Germany have increased consumption.

European producers are reported to view with some trepidation the new plants being erected in Greece, Turkey, Iran, Egypt, India, Pakistan and the mainland of China, as well as additions to existing plants. These represent long-term increases and for the next two years, the expected production is believed to be unlikely to increase beyond the figures presently known, and might be less owing to voluntary reductions and to consumption increasing all the time.

Official sources estimate actual production of nitrogen in the U.S.S.R. as follows: 1952-53, 470,000 metric tons; 1953-54, 495,000; 1954-55, 556,000; 1955-56, 626,000; 1956-57, 710,000; 1957-58, 750,000; and 1958-59, 800,000. Consumption is believed to have been greater than production owing to imports from East Germany.

Export prices from Europe have been down to £14 f.o.b. in bags for ammonium sulphate and £13 7s. for calcium ammonium nitrate. These prices are said to apply only to very heavy consuming countries, such as China and other Far Eastern destinations. Elsewhere, prices have tended to remain fairly steady. Aikman report that there seems to be no doubt that for most producers, these prices are not remunerative and it will not be long before they have to be increased, or production further reduced.

ESTIMATED WORLD NITROGEN PRODUCTION AND CONSUMPTION
(Thousands of Metric Tons)

	1957-58		1958-59	
	Prod.	Con.	Prod.	Con.
U.K.	465	435	545	500
France, Saar & Colonies	550	599	650	637
Italy	475	320	545	330
Germany, West ...	1,220	710	1,345	725
Germany, East	330	275	345	280
Spain	52	195	65	200
Poland	210	200	210	200
Egypt	30	140	30	150
U.S. Puerto Rico & Hawaii	2,950	2,950	3,100	3,100
Canada	305	85	375	90
Central & South America (not Brit. Colonies) ...	70	300	80	320
Australia & New Zealand	24	37	23	40
Japan	920	650	950	680
India	90	175	130	220
Pakistan	5	35	10	40
China	171	490	180	500
Africa (not Egypt, or Brit. Colonies) ...	45	100	45	85

The mainland of China is the largest importer and there has been considerable pressure there to get lower prices accepted, not unsuccessfully. This has been done because of the enormous potential of the Chinese market and the desire on the part of major producers to retain a share of it.

In Japan, on the other hand, owing to cancellations (for political reasons) of part of the contract with mainland China, stocks are mounting and, as storage facilities are limited, Japanese production will probably have to be cut in the near future unless large sales are made to other Eastern markets.

A tender for $22,756,000 (about 80,000 tons) of pure nitrogen for Korea was sent out in November last and for this the Japanese have bid for 375,000 tons of products at prices mostly below those of Europe and the U.S., taking into consideration differences in freight. Of these, 250,000 tons were ammonium sulphate at about $41.85; 70,000 tons urea 46% at $94.60; 5,000 tons ammonium nitrate 34½% at $66.59; and 50,000 tons calcium cyanamide at $40.90.

European producers tendered for 278,000 tons of products at as low as $41.00 for ammonium sulphate 21%; $51.70 for ammonium sulphate nitrate 26% and at $39.00 for calcium ammonium nitrate 20½%. Canadian producers tendered for ammonium sulphate 21% at $42.95-$43.50 and U.S. producers at $43.70-$51.88; the U.S., Canada and Formosa tendered for a total of 170,000 tons. All these offers were per metric ton, f.o.b. shipping ports.

The awards have been made as follows:. Japan, 70,000 tons urea, 89,000 tons ammonium sulphate, 50,000 tons cyanamide and 5,000 tons ammonium nitrate; U.S. 26,200 tons urea and 18,000 tons ammonium nitrate.

India is expected to announce shortly a tender for 50-60,000 tons of pure nitrogen. Advance information suggests, say Aikman, that Japan will get 100,000 tons of ammonium sulphate at £17 3s. 10d. and 50,000 tons urea at £38 4s. 10d., both c. and f. Indian port. Another shipment of 50,000 tons calcium ammonium nitrate 20½% is under negotiation for European producers.

NITROGEN PRODUCTION AND CONSUMPTION
(Thousands of Metric Tons)

	1955-56		1956-57		1957-58		1958-59	
	Prod.	Con.	Prod.	Con.	Prod.	Con.	Prod.	Con.
Europe and Egypt	3,798	3,318	4,172	3,675	4,691	3,977	5,181	4,169
U.S.	2,700	2,500	2,735	2,735	2.950	2,959	3,100	3,100
Canada	517	237	475	259	575	405	655	431
Asia	925	1,286	1,080	1,437	1,281	1,719	1,120	1,815
Other countries	88	219	92	278	94	315	96	1,344
Totals	8,028	7,560	8,583	8,884	9,591	9,366	10,452	9,857

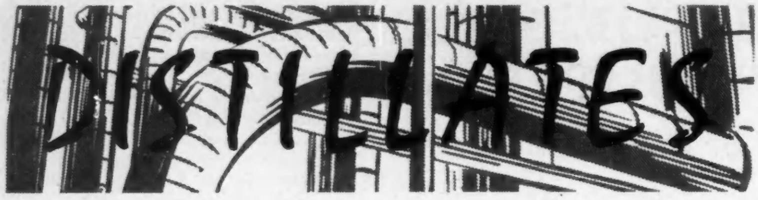
Rules for Carriage of Dangerous Goods Revised

REVISED regulations about the carriage of dangerous goods by rail which come into force on 1 January next, are contained in the second edition of the International Convention on this subject published last week. ('International Convention concerning the Carriage of Goods by Rail: Annex 1: Second Edition, 1958'; H.M. Stationery Office, price 10s.)

Changes in the regulations have been made necessary owing to recent rapid advances in the technology relating to dangerous goods and particularly as regards the transport of gases and inflammable liquids in tank wagons. There are also new rules about the handling of peroxides.

The Convention is generally accepted as the standard European code for the transport of dangerous goods. The new edition, in the form of a booklet, should be of considerable help to exporters requiring information on the packing and despatching of these materials to the Continent which, if done in the prescribed manner, should not be delayed.

Also contained in the booklet is an index of substances affected, the method of labelling and the entries required as consignment notes.



★ **Questioned** again in the House of Commons recently about I.C.I.'s relationship with the Atomic Energy Authority on the supply of beryllium, the Prime Minister said that the A.E.A. was importing the mineral beryl and was having it processed in this country. The A.E.A. was also buying metal flake from France and had a contract with I.C.I. for the conversion of the flake into metal in the shapes required.

Mr. Roy Mason (Lab., Barnsley) asked whether it was not the case that the metal would be valuable, not only to the authority, but also to the aircraft industry. Could the Prime Minister say to what extent I.C.I., which had a monopoly in this production, had been assisted by research conducted and financed by the State authority?

Mr. Macmillan replied that those were matters of the A.E.A. general administration and its day-to-day duties. He did not wish to go into great detail about them for they were not matters which he, as the Minister in charge, should try too meticulously to control.

★ **Congratulations** to Dr. C. L. Wilson, reader in analytical chemistry, Queen's University, Belfast, and one of Chemical Age's panel of book reviewers. To Dr. Wilson goes the distinction of holding the first professorship in analytical chemistry in this country.

He was recently appointed to a personal chair in analytical chemistry at Queen's University, where he took his B.Sc. in 1932 and his M.Sc. in 1933. He received his Ph.D. at Glasgow in 1936 and his D.Sc. at Queen's University in 1953. After wartime service with the Armaments Research Department, Ministry of Supply, Dr. Wilson went back to Belfast. A member of the I.U.P.A.C. analytical section's commission for microchemical techniques, he is editor-in-chief of '*Talanta*', the new international journal of analytical chemistry.

★ **When** I visited the new Esso petrochemicals project at Fawley last week I learned that apart from the ethylene and butadiene facilities, there was a potential source of other raw materials for the chemical industry, particularly other olefins. It was hoped to develop markets for these in due course and as demand builds up, to provide a U.K. production unit for butyl rubber. It was thought that stereospecific polymerisation would open up new markets for petrochemicals.

The new project cost £10 million (out of a total refinery and chemical plant investment of £68 million) and the depreciation period will be spread over 12 to 15 years. I was interested to learn that all the Esso's Fawley chemical units account for just over 1% of the crude throughput of 10 million tons. Last year, the world-wide Esso organisation spent £20 million on research and development, of which a proportion was allocated to chemicals.

Two features of the new project deserve special mention. For the first time in a U.K. refinery, waste gases are being used to drive a gas turbine for the compression of the propylene refrigeration unit on the butadiene plant. Also for the first time in a U.K. oil refinery, air coolers are used on a large scale. Supplied by Head Wrightson, these form part of the butadiene dehydrogenation unit and represent a big step forward in the prevention of water pollution.

★ **First** and second prizes in the 'caption this poster' competition organised by the Industrial Safety Division, Royal Society for Prevention of Accidents, went to Mr. W. L. Jones, a traffic assistant in the transport department of Murgatroyd's Salt and Chemical Co. Ltd., Sandback, Ches. He won the

two top prizes, worth £50 and £20 each, from a field of more than 20,000 entries.

I illustrate his entry that won the first prize. His caption that won the second prize was 'He'll tumble to it! Tidiness pays.' Among winners of consolation prizes were representatives of Bakelite, Glaxo Laboratories, Distillers Co., and I.C.I.

★ **As a** result of toxicological experiments carried out by the M.R.C. Nutritional Research Unit, Huntingdon, Abril Industrial Waxes of Golden Mile Works, Bridgend, Glam, announce that their waxes OS, 10DS, E and S which are sold to the plastics industry have been found to be completely non-toxic. The experiments were carried out to the recommendations of the toxicity sub-committee of the British Plastics Federation and show that even under conditions of complete extraction, the toxicity quotient as defined was so small as to be negligible.

As a result, the waxes concerned can be used with confidence in plastics articles and film which will come into contact with foodstuffs.

The two waxes were subjected to the research unit's standard procedure for evaluation of the oral mammalian LD50. None of the doses, which ranged from 500 mg. to 5 g/kg. bodyweight which were administered to rats produced any clinical signs or symptoms.

★ **The** ordinary chemist, it seems, turns away from naming his new compound with relief, paying scant attention to either Old Possum or the Chemical Society on the importance of names. 'Bombalurina' who has set competition No. 4 in the November issue of May and Baker's *Laboratory Bulletin*, says that poisons ought to sound venomous, sedatives be euphoniously soporific and explosives detonate into monosyllables.

Science, however, prevails over onomatopœia and chemical nomenclature is systematic and mundane. Apparently only the layman can be hilarious about long chemical names. This, thinks Bombalurina, must be the reason for the lack of chemical limericks, tongue twisters, spells and rhymes.

He invites chemists to redeem their reputation for wit by composing a limerick which exploits an authentic chemical name and to send it to the bulletin's competition editor by 31 March. First prize is five guineas.

An example of the type of limerick in mind is:

'There was a young chemist of Ryde,
Who made a foul poison and died.
It was ortho-hydroxy-
para-methoxy-
trinitrobenzaldehyde.'

★ **In the** potassium permanganate plant of a large firm of manufacturing chemists, nylon boiler suits have been found to last up to eight times as long as conventional drill garments. The process is so severe on clothing that a cotton garment is frequently completely unserviceable after three months whereas nylon, which has excellent resistance to alkalis, often lasts two years. Although a nylon garment costs about twice as much as a cotton garment there is a substantial long-term economy, in fact B.N.S. tell me that during the last 18 months sales have risen fourfold.

The story is told in 'Nylon's Overall Advantages,' just published by British Nylon Spinners Ltd., at 68 Knightsbridge, London, S.W.1.

Alembic

ROYAL SOCIETY PRESIDENT DISCUSSES MODERN TRENDS IN SCIENTIFIC THINKING

IN scientific literature of a limited period the main lines of progress were not easy to make out, Sir Cyril Hinshelwood remarked, in his presidential address on 'Some modern scientific themes' to the Royal Society Anniversary Meeting on 1 December. Mostly only trends were visible. To try and see where science stood, and where it was going, Sir Cyril briefly referred to some of the trends and characteristics of the work of the very recent past.

A reasonably plausible, although complex set of hypotheses, was emerging about the manner in which the chemical elements were formed by 'hydrogen burning,' 'helium burning,' and by neutron capture processes in the stars. In spite of all uncertainties and complications an impressive picture had emerged of the origin and relative abundance of the elements. It was interesting to note how much was still being done in a relatively simple manner in nuclear chemistry and physics generally. Nuclear synthesis, at temperatures of the order of $10^{8\circ}$K were treated in a way resembling, on a vastly magnified energy scale, the familiar calculations of chemistry.

Synthesis of 12C

Synthesis of 12C from three α-particles was envisaged as occurring in steps with the rate of reaction estimated by an integration of the Maxwell energy distribution. Theories of this kind, like the planned synthesis of isotopes, had something of the character of structural chemistry in its heyday. Reduced to its simplest terms, the project of harnessing the energy from nuclear fission in the reactions D + D or of D + T was the old problem in reaction kinetics of raising gases to an ignition temperature. With temperatures of nuclear transformations of about six orders of magnitude greater than those of ordinary chemistry there had been brought into realisation the applications of advances in electrical engineering to render possible in the laboratory what a few years ago appeared possible only in the stars.

Translation of traditional physical chemistry far up the energy scale raised an interesting speculation. In certain chemical reactions, branching chains led to the existence of critical pressures where abrupt transitions from slow reaction to explosion occurred, and the same pattern existed in the critical size phenomena of nuclear fission. In chemical systems special conditions were known where the branching and quenching of chains gave rise to periodic flames. Sir Cyril, therefore, thought it was an interesting question whether perhaps eventually the chain reactions of stellar alchemy might even explain in an analagous way the mystery of the Cepheid variables.

One of the profoundest problems facing science today was that of the so-called elementary particles themselves. Even in the 'bizarre and hardly credible world' of mesons, neutrons, hyperons, strange particles and the like there occurred phenomena still oddly reminiscent of the simpler kinds of chemistry —'Positronium' was now known in its *ortho* and *para* forms and mesons could be made to function as catalysts for nuclear reactions.

The homely analogies failed when confronted with the attempt to interpret the nuclear particles themselves, and mutual interaction and decay. Some completely new principle, it seemed, was needed.

More and more remarkable facts were being revealed, largely by the technique of scattering experiments, carried out by means of the accelerating machines.

Last year the Moscow conference on the origin of life had brought to focus a further series of interrelated problems. The original terrestial atmosphere was probably a reducing one containing methane, ammonia and hydrogen, from which amino acids, and by stages a complex store of organic compounds could be accumulated.

The working of the machine by which genetic information was translated into cells and into complex individuals was the central problem of biology, and this was being studied at many levels: such as by work on the basic chemical structures themselves, on changed amino acid sequences in the proteins of mutants, on the persistence of biochemical functions in living material, on the separation and reconstitution of virus components, on interference with virus growth, on the unbalanced growth of cells exposed to abnormal conditions, etc. Much interest centred on nucleic acids and pure form was illustrated by the many chemical studies on the structure of nucleotides, nucleic acids, polypeptides and proteins. Sir Cyril quoted as recent example the synthesis of peptides containing sequences found in the natural compound argenine-vasopressin.

One observation of great interest was that of Roberts and co-workers who had found that a clear preparation of certain cellular juices to which manganous ions were added might after a period of delay give rise to particles ('protomorphs'). These possessed variable synthetic ability and seemed to represent an intermediate state between the organisation of the cell and the disorganised condition of the juice. Also Utter, Keech and Nossal had observed that yeast cells contained sedimentable subcellular units which had enough organisation to effect complete biochemical reactions.

Intact cells studied under abnormal conditions had yielded, said Sir Cyril, most valuable information, as for instance when protein synthesis was inhibited by certain drugs, but ribonucleic acid synthesis continued. Proteins and nuclei acids, genes, chromosomes and nuclei, cells and early embryos were thus yielding suggestive glimpses of the fundamental mechanisms of the biological machine.

Sir Cyril pointed out that none of the details of the story that was unfolding was won without expert labour. It was all too easy, he said, to think of detailed and absorbing work as an end in itself. If this temptation was yielded to science would fail to occupy that place in the scheme of things which was its rightful due.

Work of Royal Society's Medal Winners

BEFORE addressing the Royal Society on the occasion of the anniversary meeting held on 1 December, the president, Sir Cyril Hinshelwood, dealt with the Society's awards of medals for 1958.

The Rumford Medal has been awarded to Sir Thomas Merton, K.B.E., F.R.S., who has devoted himself to research in spectroscopy for close on 50 years. Although his early papers dealt with absorption spectra he soon turned to the emission spectra of gases and the causes of the variations in the spectra produced under different conditions. Merton's Bakerian Lecture in 1922 on the spectrum of hydrogen cleared up a number of discrepancies in the secondary spectrum of hydrogen which was shown to be due to the hydrogen molecule. It also emphasised the profound influence which traces of impurities can have on gas spectra. This was the subject of a number of subsequent papers dealing mainly with the influence of the rare gases on the spectra of other elements. All his work had been distinguished by the elegance and ingenuity of his experimental methods.

The rarity and expense of good diffraction gratings led Merton to devise in 1935 a method of copying them without loss of optical quality by applying a thin layer of a cellulose ester solution to an original plane grating. In 1948 Merton made an important basic advance in the science of ruling diffraction gratings, ruling a very fine helix continuously on a steel cylinder which he then opened out upon a plane gelatine-coated surface by his copying method.

These processes were passed to the N.P.L. for further development. The 'blazed' gratings made by the Merton-N.P.L. method are already of great value in making available cheap infra-red spectrometers of high resolving power which are finding many applications in research and industry.

Professor H. S. W. Massey, F.R.S.,

University College, London, has been awarded a Royal A Medal. The professor is distinguished alike in the fields of experimental and theoretical research. His early experimental work was concerned with elastic and inelastic collisions between electrons and atoms. In collaboration with Bullard he carried out a series of experiments in which diffraction effects were demonstrated and studied in detail.

Besides developing equipment for upper atmospheric exploration, Massey is engaged in assembling more powerful apparatus for the laboratory investigation of collision process.

This year the Davy Medal has been awarded to Professor R. G. W. Norrish, F.R.S., Cambridge University, who has made many notable contributions to physical chemistry, particularly in elucidation of photochemical change, combustion of hydrocarbons and development of experimental methods for the study of rapid reactions.

His early investigations of the catalysis reactions of the combination of hydrogen and chlorine and hydrogen and oxygen considerably clarified many features of these reactions. The general acceptance of the chain nature of these reactions and the wider recognition of the occurrence of chain reactions led him to explore the mechanism of the photochemical dissociation of complex organic molecules, particularly the aliphatic ketones, and also to embark upon a considerable series of studies of the thermal and photo-chemical oxidation of hydrocarbons and related substances. These researches have been of outstanding value in the understanding and interpretation of chain reactions.

In the field of complex processes of addition polymerisation Professor Norrish has made significant contributions. He and his co-workers were among the first to recognise the now well-known 'gel effect', and to elucidate the kinetics of copolymerisation and the features of heterogeneous polymerisations. 'Flash photolysis' which the professor has developed has become one of the most important techniques for the study of fast reactions and among other applications the method has been used successfully in the measurement of the new radical spectra, the study of rate of atom reactions and the investigation of explosive phenomena.

This year the Hughes Medal has been awarded to Professor E. N. da C. Andrade, F.R.S. His experimental investigations have covered a wide field of physics and has made considerable contributions to the domain of viscosity of liquids, including liquid metals; and to metal physics, including the properties of single crystals.

He has derived a formula for the variation of viscosity with temperature. He has also derived a formula which gives the viscosity of a liquid at the melting point, as a simple function of the atomic weight, density and temperature, free of any arbitrary constant. This formula has been used with success to predict the viscosity of liquid helium. Andrade has also established the (very small) effect of an electric field on the viscosity of a liquid, an effect which had been vainly sought for over sixty years.

In metal physics Andrade has done much original and ingenious work. The relative importance of the two forms of creep has been shown to depend on the temperature relative to the melting point. Recent books on the subject consider Andrade's early work on creep fundamental.

Nyholm on Recent Advances in Structural Chemistry of Nickel

RECENT advances in structural inorganic chemistry with reference to nickel was the subject of a lecture by Professor R. S. Nyholm, Professor of Chemistry, University College, London, at a meeting of Kent sub-section of the R.I.C. recently.

Nickel was known to exhibit all the five oxidation states from 0 to +4. In the zerovalent state, e.g., $Ni(CO)_4$, the compounds were tetrahedral. At the other end of the scale, complexes of Ni(IV), e.g., K_2NiF_6, which was diamagnetic, were usually octahedrally co-ordinated. The complexes of tervalent nickel were five-covalent, e.g., $NiBr_3$, $2Et_3P$ or six-covalent, e.g. $[Ni(Diarsine)_2Cl_2]Cl$. The former were presumably square pyramidal in shape while the latter were probably teragonal like the derivatives of bivalent palladium of the type PdI_2.2Diarsine. Little was known of the stereochemistry of univalent nickel complexes having the formula $K_2Ni(CN)_3$ stated Professor Nyholm; from its diamagnetism this compound was apparently dimeric.

Bivalent nickel gives rise to two kinds of complexes, some of which were diamagnetic and others which had two unpaired electrons. The diamagnetic complexes were either four-covalent and square, e.g. $NiCl_2.Et_3P$ or five-covalent and presumably square pyramidal, e.g., $NiBr_2$.triarsine. The paramagnetic complexes were usually six-covalent with an octahedral stereochemistry, e.g. $[Ni(NH_3)_6]Cl_2$. However, there had long been doubt as to the existence of four-covalent paramagnetic nickel complexes, the professor reported.

Until recently only the compounds $Ni(NO_3)_2.2Et_3P$ and $Ni(acetylacetone)_2$ were believed to involve four-covalent nickel. The latter had been shown to be a trimer, probably involving six-covalent nickel, while the former could, at least theoretically, be formulated with a chelated nitrate group making the nickel atom six-covalent.

Recently Venanzi and Powell had shown clearly that the paramagnetic compound $NiBr_2.2Ph_3P$ involved tetrahedrally co-ordinated nickel, there being considerable distortion from the regular tetrahedral angle. Investigation by Dr. Naida Gill and Peter Pauling at University College, London, had also added to the knowledge of this problem.

In connection with some studies of the structures of compounds of the type $M^{II}(hal)_2$.2pyridine, salts of the general formula $(Ph_3MeAs)_2[M^{II}hal_4]$ had been prepared. As expected from the application of ligand field theory, those complexes wherein the metal atom had a d^5 (mnII), d^7 (CoII), or d^{10} (ZnII) non-bonding electronic configuration were isomorphous and were bi-univalent electrolytes in nitrobenzene. Since the magnetic moment and colour of the Co(II) complex was that expected for tetrahedral co-ordination it was concluded that all these compounds were tetrahedral.

Professor Nyholm said that if it was found that the corresponding Ni(II) complexes could be obtained also, where hal = Cl, Br and I. These compounds were isomorphous with their cobalt analogues and X-ray studies on single crystals had established that the Ni(II) atom was tetrahedrally co-ordinated. The very high magnetic moment (3.9 B.M for the chloride) indicated the high orbital contribution expected for tetrahedral co-ordination. An explanation of the existence of these four-covalent bond formation. The simple crystal field theory held for purely electrostatic complexes and the presence of covalent binding could lead to co-ordination numbers other than which the simple electrostatic theory predicted. The professor discussed also the circumstances under which crystal field stabilisation energies might be unreliable.

Norwood Course on Microchemical Methods

STARTING on 10 January, a course of 12 lectures and appropriate practical work will be held on Saturday mornings at the Norwood Technical College, from 9.15 a.m. to 12.30 p.m. Particularly suitable for teachers, industrial and research chemists, the course is designed to survey the principal branches of chemistry in which small-scale methods have been successfully applied.

Application forms for admittance are available from the secretary of the college at Knight's Hill, London, S.E.57. London fee for the course is £1.

Kingston Course on Protein Chemistry

A course of postgraduate lectures on 'recent advances in protein chemistry' is to be held at the Kingston Technical College, on Tuesdays, starting at 7 p.m., on 13 January in the new college building, Fassett Road, Kingston-upon-Thames. Fee for the course is £1 2s. 6d. Among the distinguished lecturers will be Dr. F. Sanger, F.R.S., winner of the 1958 Nobel Prize for chemistry. His subject will be 'Amino acid structures of proteins.'

Increased Epoxide Resin Production

Bakelite Limited announce that, following substantially increased demands for their epoxide resins, production capacity has been increased by 60%.

AUTUMN GAS RESEARCH MEETING—3

Hydrogenation of Light Distillate and Production of Aromatic Hydrocarbons

PETROLEUM refinery product, known variously as light distillate, primary flash distillate or light virgin naphtha is now available in substantial quantities and is likely to remain so for some time. Having regard to its volatility, the ease with which it can be stored and its very low sulphur content, the gas industry has examined it as a raw material for gas manufacture. Pressure hydrogenation of paraffinic light petroleum distillate at temperatures above 700°C will give hydrocarbon-rich gas of calorific value up to about 850 B.Th.U./cu. ft. About 500 gall. of distillate is required per 1,000 cu. ft. hydrogen, with almost complete conversion to gaseous hydrocarbons, principally methane. With heavier feedstocks (e.g., gas oil) it was found that there were substantial yields of benzene and other aromatic hydrocarbon by-products.

Pilot Plant Work

Pilot-plant hydrogenation of light distillate indicated that there was a possibility of producing benzene and other aromatic hydrocarbons with this raw material. The many practical advantages of using light distillate, it was suggested, could be exploited, while at the same time, there would also be a substantial yield of aromatic hydrocarbons, principally benzene, to credit against raw material costs. It was observed that when there was imperfect mixing of oil vapour and hydrogen, a little benzene was synthesised, and it was considered that aromatic hydrocarbon formation might be encouraged by restricting the opportunity for hydrogenation to methane by expressly using higher oil; hydrogenation ratios; or by lowering the pressure.

Studies described by Dr. L. A. Moignard and K. D. Stewart, Midlands Research Station, The Gas Council, have shown this to be the case. They presented a paper on this subject at the Autumn Gas Research Meeting (see also CHEMICAL AGE, 29 November, and 6 December).

In their paper 'Hydrogenation of light distillate with reference to production of by-product aromatics', these workers state that it has now been found that when the oil:hydrogen ratio is increased, into the range 10 to 30 gall./1,000 cu. ft. hydrogen, aromatic hydrocarbons are synthesised at temperatures between 700° and 800°C; up to 20 to 25% of the carbon in the feedstock can appear in this form. Yields appear largely independent of pressure and can be obtained with hydrogen-rich fuel gases as well as with commercially pure hydrogen. When the oil already contains aromatic compounds these contribute to the yield.

First experiments were aimed at establishing whether the synthesis of aromatic hydrocarbons could be confirmed under conditions of restricted opportunity for hydrogenation. Gas and aromatic hydrocarbon yields are calculated on the assumption that benzole recovery is complete and that the gases dissolved in the condensates under pressure are recovered and added to the main stream when the oils are withdrawn from the system. It was demonstrated that at an oil feed rate of 11.6 gall./1,000 cu. ft., benzene and toluene were formed as the oil supply increased, production of benzene tended towards a limit. It was found that, at the lower oil rate, only 0.6% of incompletely reacted distillate appeared at 725°C, as compared with 2.0% at 700°C.

At the higher rate, a higher temperature was required for the substantial elimination of this material. Raising the temperature was found to lead to more extensive, although far from complete, hydrogenation of the unsaturated hydrocarbons. Higher paraffins tended to be hydrogenated to methane, although at 800°C a substantial proportion of ethane escaped reaction.

Influence of Pressure

The influence of pressure was examined. Differences in yields when hydrogenation reactions were carried out at 10 or 25 atmospheres were reported as not being in themselves sufficient to determine the practical choice of an operating pressure. It was the gas composition that was found to change most on increasing the pressure, more hydrogenation of unsaturated hydrocarbons to paraffins occurring. Of the effect of feedstock characteristics, Moignard and Stewart state that material (distillate 'A') boiling at 40° to 72°C cannot be regarded as characteristic of light distillate that the petroleum industry will seek to distribute. The heavier end of the range within which their oil company intended to operate had a boiling range of 100° to 185°C. This latter, described as distillate 'B,' contained besides toluene, the xylenes and their isomer ethylbenzene, eight compounds of composition C_9H_{12} all of which boil within the range while of the 20 $C_{10}H_{14}$ substances, 14 do so. Results have suggested that more synthesis from paraffins takes place with distillates 'B' than with 'A.' The differences are much smaller as regards monocyclic aromatics (24.4 and 19.0) and much smaller still for benzene itself (7.3 and 3.9). Thus hydrogenation of high concentration of distillate 'B' favours synthesis of more complex aromatic compounds than of the simpler ones and so the proportion of benzene to total monocyclics and to aromatic compounds as a whole is less with 'B' than with 'A', and less at a high than a low oil feed rate.

Using distillate 'B' at a feed rate of about 25 gall./1,000 cu. ft. of hydrogen at 25 atm. at 750°C fluidisation was found to cease soon and dismantling showed that much carbon had formed. On this account, heavy oil, it is considered, may prove more difficult to use at the highest feed rate, but results have indicated that much less advantage would accrue from doing so than with the light oil of type 'A'.

In so far as *cyclo*paraffins are constituents of the distillate, they, it is reported, will make a larger contribution to aromatic hydrocarbon production than a straight-chain paraffin. Nevertheless hydrogenation to methane and ethane has been found to predominate strongly. There is also some doubt how far aromatics are produced from these compounds by dehydrogenation alone since no more toluene and no less benzene is formed from methyl-*cyclo*hexane than from *cyclo*hexane.

Two Groups of Tests

Two groups of experiments have been carried out using hydrogen-rich fuel gases for hydrogenation. In one the hydrogenating gas resembled in composition an unenriched Lurgi generator gas (H_2, 65% by vol.; CO, 20%; CH_4, 14.5%; CO, 0.5%) and in the other it was town gas. With Lurgi gas at 20 atm. and total pressure of 10 atm., yields of aromatic hydrocarbons were a little lower and carbon deposition more in evidence.

Production of benzene and naphthalene: Laboratory experiments with light distillate 'B' indicated that the hydrocarbons present, in whatever form, were related to the quantity of oil from which they originated; the quantity of hydrogen included both the hydrogen coming forward from the synthesis unit, whether reacted or not.

It has been found that a large proportion of the toluene and all the xylene and other monocyclic hydrocarbons formed in the synthesing reactions are eliminated, as such, in the hydrogenating reactor, while the higher aromatic compounds appear to contribute partly to naphthalene and partly to an increase in the amount of carbon deposited.

Pure Benzene Production: In the experiments to demonstrate production of pure benzene, commercial silica-alumina material specially prepared in microspheroidal form for easy fluidisation was used; coke could not be used as the fluidised bed material on account of its sulphur content. Because of the catalytic

Gas Research Meeting

properties of the silica-alumina in hydrocarbon reactions, performance of the bed was explored before using it for benzene preparation.

In a run of 36 hours' duration for the preparation of sulphur-free condensate, 4,740 gm. purified distillate were supplied and 1,067 gm. condensate were recovered from it, the fraction boiling up at 205°C (880 gm.) was obtained by distillation; this had the following composition: benzene 36.7% by weight; toluene, 31.4%; xylene, 18%; other monocyclic aromatics, 12.4%; and naphthalene, 1.1%. The balance of 0.4% represented incompletely reacted aliphatic hydrocarbons. Hydrogenation treatment completes the destruction of these and removes as well the substituent aliphatic groups from the benzene nucleus.

After hydrogenation of 800 gm. of feedstock at 800°C, a time of contact of 10 sec., a pressure of 10 atm. and an oil: hydrogen ratio of 5 gall./1,000 cu. ft. of hydrogen, 606 gm. of condensate was obtained, of composition: benzene, 97% by weight; toluene, 2.0%; and xylenes 1.0%.

Free from Sulphur

The benzene produced by distallation was found to be free from sulphur and to contain too little impurity to be significantly different in any respect from pure benzene. The yield, on the carbon basis was 14.1% but this figure does not include the benzene leaving the apparatus uncondensed in either the synthesis or hydrogenation treatment.

A sample of benzene obtained from feedstock containing 350 p.p.m. of sulphur and a benzene concentration of 8 p.p.m. was examined crystallising point was 5.45°C. Sulphur apart, this benzene was stated not to be significantly inferior to that produced from purified distillate. Total sulphur content was within the range allowed (10 p.p.m.) for synthesis grade benzene, although it was noted that this might fail if sulphur was present as either thiophen or carbon disulphide.

Hydrogenation process for gas manufacture: The possibility has been considered of developing a self-contained process, requiring only light distillate and water as its basic raw materials which would generate its own hydrogenerating gas and produce, besides aromatic hydrocarbons of high quality, town gas of a chosen calorific value, low in CO content and free from sulphur, without admixture of gas from any outside source, making it available under pressure for immediate distribution.

A possible plant was described by Moignard and Stewart. Internal and external heat exchangers that would be used to maximise thermal efficiency only were omitted from the description.

(I) *Evaporation and purification of distillate*: Distillate is pumped into the plant and after being vaporised at the working pressure, can be purified using Cockenham and Percival's method (*Gas Council Res. Comm. GC41*, pp. 36, 1957). Some hydrogen is added and the mixture is passed to a vessel containing molybdenum sulphide catalyst at 350° to 380°C. The sulphur compounds are quantitatively converted into H_2S, which is absorbed by iron oxide at the same temperature. This ensures that the entire plant is sulphur-free thenceforward. Final gas requires no purification, the hydrocarbon gas can be admitted without treatment to the nickel catalyst in the reformer and by-products are of synthesis purity.

(II) *Distillate hydrogenation*: Purified oil vapour with a substantial amount of hydrogenating gas is admitted to the base of the hydrogenator, containing a fluidised bed of carbon dust. In the lower section the paraffin fraction is decomposed some forms aromatic hydrocarbons by synthesis, some is hydrogenated to methane and ethane, and some remain as simple unsaturated hydrocarbons. Some dealkylation of aromatic compounds present in the feedstock may occur.

When the gases and vapours reach the base of the upper section, hydrogenating gas is introduced to convert the aromatic hydrocarbons to benzene and naphthalene. Increase in diameter of the vessel at this point is needed to accommodate the additional volume of gas while keeping linear velocities within convenient limits of fluidisation.

Temperature Range

Depending on the distillate used reactions are likely to require temperatures within the range 725° to 800°C (maintained by preheating hydrogen and oil supplies to 350° to 450°C. With some oils, it may be desirable to recycle the coke beds to maintain reaction temperatures in the lower section.

In the uppermost part of the bed coils are used to preheat hydrogenating gas and oil vapour cooling the reaction products to 500°C. The products consist of a gas of high calorific value (H, CH_4 and C_2H_6, and a mixture of aromatic vapours, predominantly benzene and naphthalene, with some heavier compounds). Provision is made for withdrawing carbon deposited on the bed. A cyclone returns to the reactor dust entrained by the gases.

(III) *Cooling and condensation*: Gases and vapours enter a hot scrubber in which the heavier aromatic fraction is condensed. Scrubbing is achieved by recycling condensate from a tank from which heat can be abstracted by enclosing the oil evaporator and a preliminary hydrogenating gas preheater within it. The scrubber is followed by a water-cooled tubular condenser in which benzene is recovered. Both condensates need distillation before pure products can be marketed.

(IV) *Production of hydrogenating gas*: The gas is made by using a part of the hydrocarbon gas issuing from the benzene condenser to decompose steam by the endothermic methane-reforming reaction.

To supply reaction heat, it is proposed to develop a pressure reformer. This would consist of a single insulated shell in which hydrocarbon gas mixed with steam reach at essentially the same pressure as that of the hydrogenator. Heat would be supplied by burning some of the hydrocarbon gas in a combustion chamber, located inside the catalyst bed and operating at the same pressure.

Steam for reforming would be raised in a boiler heated partly by the waste gases before they reach a gas turbine and partly by combustion of some of the hydrocarbon gas.

Catalyst in the form of a fluidised bed in the space surrounding the combustion chamber and tubes would facilitate heat transfer and enable the system to be uniformly heated at 800°C. The combustion system can be fabricated from relatively light material if the burner operates on the gas-rich side so that there is no oxygen in the combustion products.

A cyclone at the offtake returns catalysts to the reformer, and there are filters that retain the last traces of dust.

Clean Reformed Gas

Clean reformed gas passes, after cooling to 400°C to the CO conversion unit, carrying with it ample undecomposed steam for the water-gas reaction CO_2 produced is removed by means of hot K_2CO_3 solution which can be regenerated by heat-exchange with the incoming gas. Finished hydrogenating gas is then cooled. Apart from a small amount required for distillate purification, it is divided between the hydrogenation and the final town gas stream.

Sizes and quantities: For a plant making 5 million cu. ft./day of town gas of calorific value of 500 B.Th.U./cu. ft. and density 0.48, from distillate from which a yield of benzene of 20% (approximately) is obtained, the following figures have been obtained.

Vessel sizes	*Height (ft.)*	*Diameter (ft.)*
Oil purification:		
Catalyst bed	10	3.5
Absorber bed (filling to last one month)	10	3.5
Hydrogenator:		
Lower section, internal ...	10	5.25
Upper section, internal ...	21	7.25
Reformer:		
Catalyst bed	18	7.75
CO Converter:		
Catalyst bed	14	6.25

Quantities supplied and produced:

Supplied	*Per day*	*Therms/day*
Distillate	27,650 gall.	43,075
Produced:		
Gas (500 B.Th.U/cu.ft.)	5 × 10 cu. ft.	25,000
Benzene	5,150 gall.	7,500
Naphthalene ...	4.30 tons	1,675
Higher aromatics ...	2.55 tons	995
Carbon	4.02 tons	1,305
		36,475

Thermal efficiency of process $\frac{36,475}{43,075} \times 100 = 84.7\%$

A provisional patent specification (No. 23389/58) has been filed to cover processes based on the findings of this paper. It is entitled 'Improvements in the Gasification of Hydrocarbon-containing Oils.'

Gas Research Meeting

Gas Chromatography for Analysis of Town and Refinery Gases

ACCURACY comparable with that of conventional methods was obtained when Boreham and Marhoff used gas chromatography for the analysis of town gas. The gas industry appreciated the potentialities of the technique for the analysis of gases, benzoles and tar fractions and work was now in hand at the London Research Station of the Gas Council to improve the methods still more.

One of the important pieces of the apparatus in gas chromatography was the detector which must be compact, sensitive and fast in response. Particular attention was being paid to the application of new and sensitive detectors and it was hoped to determine naphthalene and tetrahydrothiophen (THT) directly in a small gas sample by using the argon detector.

Mixtures of organic and inorganic acids always cause difficulties on a chromatographic column and the authors had to find a method that would take no longer than conventional methods but would give an accuracy at least within 0.1% by volume for each constituent.

Vapour Fractometer

Of the many commercial instruments examined, the Perkin-Elmer vapour fractometer proved to be the best because the thermal conductivity type of detector had greater sensitivity than the normal platinum wire katharometer at the low temperature required for analysis. One drawback of this sensitivity was that small changes in carrier gas pressure and flow rate would result in an unsteady base line and a further value was added to the supply cylinder as a control. The attenuation system of reducing the signal to the recorder was of wide range, giving the apparatus versatility over large ranges of gas concentration. Sample sizes could be varied between 0.25 and 25.0 ml. and this range was essential for the type of analysis being undertaken. Another disadvantage of the apparatus was that the instruments (thermometer, etc.) provided were not sufficiently accurate for automatic analysis.

The purpose of the investigation was to establish which combination of columns would give a separation of the maximum number of constituents of town gas in the shortest space of time. It was established by the authors that the eight major constituents, CO_2, O_2, H_2, N_2, CO, CH_4, C_2H_4 and C_2H_6 could be qualitatively separated and identified in less than one hour using a combination of the chromatograms obtained from a 2-metre length of silica gel (40-60 mesh) and a 2-metre length of Linde molecular sieves Type 5A (40-60 mesh). Propane, propylene and acetylene could be detected over a longer period if present in any appreciable concentration. Later work on quantitative procedure determined H_2, CO, CH_4, C_2H_6, CO_2 and C_2H_4 on the silica gel column and O_2 and N_2 on the molecular sieve column. This combination reduced the time required on calibration.

When thermal conductivity was used as the sensing device the only accurate measurement of the gas concentration in a mixture required the correlation of a known concentration of the gas with the corresponding peak height (or area) of the chromatogram. The design of the thermistor was very important as conduction was not the only means by which heat was dissipated. Convection and radiation were also concerned but in correctly designed thermal conductivity cells, their effect was greatly minimised.

Calibration of the columns was most important and the authors spent a considerable time on it to prove the reliability of the technique. After a series of experiments it became apparent that as the sample pressure decreased there was an increasing deviation of component concentration from the true values. Final calibrations were therefore effected close to atmospheric pressure.

Two synthetic mixtures containing the 8 major components of town gas were analysed to compare the total volume of constituents determined with the corrected sample volume, and the results are summarised in Table I.

In the chromatographic technique, no constituent is determined by difference because argon is the carrier gas and no error can arise by incomplete combustion of hydrocarbons.

Two samples of town gas of different character illustrate analyses involving the determination of further unsaturated hydrocarbons and the results are illustrated in Table II. Acetylene and *n*-propane were determined from a silica gel column using argon carrier gas at about 5 l./hour while benzene and toluene were determined from a tricresyl phosphate column with hydrogen as carrier gas. Time taken for each complete analysis was 80 minutes. Development of this method of analysis was not yet complete but the experience gained had been invaluable.

TABLE 2

Full analysis of two different samples of town gas

Gas	Mixture 1	Mixture 2
CO_2	9.7	3.5
O_2	0.0	0.4
C_2H_4	4.1	2.2
C_2H_2	0.3	0.2
C_6H_6	1.4	0.2
C_7H_8	0.03	0.0
H_2	39.3	40.2
CO	12.0	14.6
CH_4	27.5	14.5
C_3H_6	0.3	2.9
n-C_3H_8	0.0	0.0
N_2	5.7	21.5
Total ...	100.33	100.2

Raw material for gas manufacture had changed considerably in the last few years. In certain new processes where refinery gases are 'cracked' to a low calorific value in one step, enrichment of this gas was necessary. These refinery gases were predominantly organic gases of low molecular weight but there could be as many as 20 to separate and analyse quantitatively. Most laboratories, especially those of the oil companies, had changed to gas chromatography.

Janak's method was simple and the apparatus could be made in the laboratory almost entirely of glassware. It required no expensive potentiometric recorder because it incorporated an integral detector. The accuracy of the results, which were very reproducible, depended on the accuracy of the burette calibration, but the total volumes of the separate components measured should be within 0.3% of the volume capacity of the gas-sample bulb. Solution of the organic gases in the aqueous KOH, which could be another source of error, could be largely eliminated by ensuring that the temperature of the liquid was low and that the nitrometer volume was not too great. The method was suitable for gases that did not condense at room temperature, limiting the scope up to and including all C_4 hydrocarbons. Any inorganic gases in the refinery gas could be adsorbed by charcoal and when that technique was used the columns need not be maintained above room temperature.

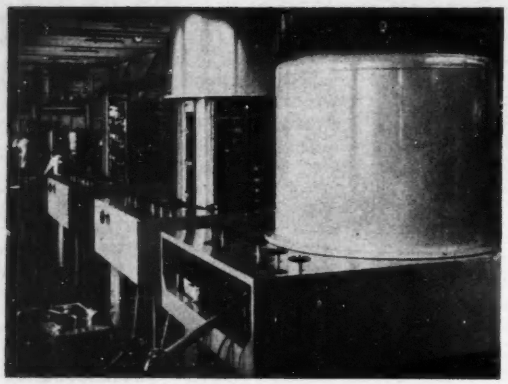
Tetrahydrothiophen

Deliberate odorisation of reformed refinery gas had added the problem of determination of a small concentration of tetrahydrothiophen (THT) in a very large volume of gas. Knowledge of the concentration of the odorant was a check on its steady rate of addition to a gas stream. Specific colorimetric or chemical analysis of THT was nearly impossible due to the presence of other sulphur compounds, but gas-liquid chromatography provided a physical method of separation and a means for its quantitative measurement.

In the analytical procedure for determination of THT, the gas is passed through a specially constructed and highly efficient bubbler containing a known volume of a high-boiling organic solvent such as *cis*- and *trans*-decalin or liquid paraffin. The flow rate was very low and it took between 15 and 24 hours to strip a sufficient quantity of the THT from the gas stream. It was possible to estimate quantitatively down to $1.2\mu g$. THT/l. of gas $\equiv$ 1.2 oz. THT/million cu. ft. of gas. The efficiency of the column decreased markedly as the weight of the chromatographed liquid was increased.

TABLE I

	CO_2	O_2	C_2H_4	H_2	CO	CH_4	C_2H_6	N_2	Total	Percentage Error
Mixture 1 ...	0.76	11.20	0.16	33.49	4.98	5.10	0.41	43.55	99.65	—0.15
Mixture 2 ...	0.00	6.59	0.00	53.27	7.06	8.07	0.68	24.18	99.85	—0.15



The three drying units under test at the factory of Edwards High Vacuum. Each unit has been supported for the test, but when installed at the Czech streptomycin plant the cabinet will be at floor level

CZECHS BUY STREPTOMYCIN VACUUM PLANT FROM EDWARDS

A SPECIAL vacuum plant for export to Czechoslovakia for freeze-drying large quantities of streptomycin has recently been completed by Edwards High Vacuum Ltd., Manor Royal, Crawley. The complete equipment will process 300 l. of streptomycin salt daily and in 22 hour cycles.

The vacuum drying section of the plant consists of three identical drying chambers, each cylindrical with a vertical axis and in two sections. The upper part of each chamber comprises a metal bell which can be raised or lowered on a cable by means of a hoist. When lowered and in position this part of the chamber contains a vertical stack of 10 shelves with a total shelf area of 110 sq. ft., the spacing between the shelves being about 3½ in. These shelves are mounted above the lower half of the chamber and project into the upper half. Special guides prevent rotation of the bell and fouling of the shelves. The two halves of the chamber are sealed by means of an elastomer cord in a trapped groove, machined in the flange in the lower part of the chamber.

Bacteria Trap

Each shelf supports four stainless steel trays complete with lids, so arranged that they permit a flow of vapour while providing a trap for airborne bacteria. The maximum load of each drying chamber is 100 l. which is achieved by each tray accommodating 2.5 l. of fluid and thus each shelf holding 10 l. The shelves can be refrigerated to -35°C, or below if necessary, by the circulation of cold alcohol. The underside of each shelf also carries a thermostatically controlled mat type electric heater operating at a reduced voltage to prevent arcing under vacuum.

The lower section of each drying chamber is supported within a sealed cabinet mounted at floor level. The base of the chamber is designed to project through the floor into a machinery space which would contain refrigeration equipment (in this case supplied by the customer). This part of the chamber contains specially designed and baffled condenser coils which are refrigerated by the circulation of alcohol at a temperature of -50°C. Provision is made for defrosting the coils by flooding with warm water or water at room temperature. According to the temperature of the water, defrosting of ice resulting from complete freeze-drying cycle takes from 15 to 45 minutes.

Pumping equipment for each chamber comprises one of the new large capacity Speedivac rotary vacuum pumps, which is backed by a smaller single-stage Speedivac pump.

Recording and control instruments are mounted in one central panel which can be fitted flush to the wall of the operating room and serviced from outside. Provision is made for the recording and indication of vacuum in a system and by means of thermocouples provision is also made for recording temperature in any three trays and alcohol entering and leaving the condenser coils. These records are made in six distinguishable colours. A selector is provided so that an indication may be obtained on an additional meter of the temperature of each of the 10 shelves in sequence.

Throughput of the complete equipment depends largely on the characteristics of the material which is being dried, its concentration and its depth in the trays (maximum 15 mm.). However, it was primarily designed to freeze and dry, to a moisture content of 1.5%, 300 l. of a streptomycin salt, 11 mm. deep in the trays in a 22 hour cycle including loading, filling, pre-freezing and defrosting. Lower moisture contents can be obtained by adjusting temperature and drying time.

U.S. Chemical Industry is Having Worse Time than Us, says I.C.I. Chairman

THAT I.C.I. would have suffered the fate of U.K. industry, the production index for which had fallen by some 3% from last year's peak, were it not for the fact that sales of new products enabled the company to maintain turnover, was a point made by Sir Alexander Fleck at the recent meeting of the company's central council. Bearing in mind the large amount of additional new capital that I.C.I. had invested, they had hoped for something bigger.

Sir Alexander said that a number of plants had been working at well below normal capacity; in addition there had been increases in wages and salaries and in the cost of fuel and transport. For the most part, however, prices had not been raised. Dealing with provision for depreciation, he said that a reassessment of plants made early in 1958 had shown that it would cost appreciably more to replace them when that should be necessary.

The company's sales had been better than expected in some sectors, and not as good as expected in others.

In the first six months of this year, the leading U.S. chemical companies had fared very much worse. Their profits were 30-40% down on the same period of 1957, compared with 'our own decrease of 15%'. The recession in the U.S. appeared to have passed its worst and there were several indications that the American economy was improving.

Speaking of the Monopolies Commission inquiry into the fertiliser industry, he referred to the company's long connection with fertilisers going back to the original construction of Billingham in the early 1920's. He felt not only that I.C.I.'s activities had not been against the public interest but that in fact the company had made a positive contribution to the industry. The report was due next year and he hoped that their positive achievements would be brought out.

Referring to his visit earlier this year to the Toya Rayon Co.'s Terylene plant three days after its official opening, Sir Alexander said he was impressed by the fact that the whole plant, which had been built on a green field, was operating 14 months after the receipt of the working drawings. He added that 95% of the equipment, which was largely a replica of the Wilton Terylene plant had been produced locally.

New Method for Determining Methanol

THE NEW B.S.506 1958 'Methanol' (13 pp., 3 diagrams), one of a series of British Standards for solvents and allied products, supersedes the 1950 edition. The main changes are the introduction of specific gravity limits at 25/25°C for use in tropical climates; the inclusion of a test for miscibility with water; replacement of the limit test for aldehydes and ketones in the earlier edition by a method for determining them.

Appendices deal with methods of determination of: distillation range; residue on evaporation; acidity; sulphur and sulphur compounds, etc.

Copies are available from the B.S.I., Sales Branch, 2 Park Street, London W.1 (price 4s. 6d.).

B.S. on Fusion-welded Pressure Vessels for Chemical and Allied Industries

INDUSTRY'S comments on and criticisms of the provisional (1949) edition of B.S. 1500 have been taken into account in the new standard B.S.1500:1958, which deals with carbon and low alloy steel pressure vessels and supersedes the portions of B.S.1500:1949 that dealt with vessels made from these materials.

British manufacturers had stated that they had been handicapped in the export trade because the design stresses imposed by B.S.1500 were too severe. Action is being taken to obtain those data on lower factors of safety, with a view to taking further steps as soon as possible.

As the petroleum industry makes very wide use of pressure vessels, full consideration has been given not only to British practice, but also to the experience of the U.S. petroleum industry. Because the design of pressure vessels, particularly in the chemical industry, is the subject of continuous development, it is intended to keep the standard under review in order to incorporate any desirable modifications.

Design, materials, control of quality, and weld joint factor, are considered, and included in the fully-illustrated publication are:

Materials and design stresses	Pressure tests
End plates	Design of cylinder shells
Flat covers	Conical ends
Branches and components	Tube plates
Manholes and inspection openings	Stayed surfaces
Full face and narrow face joint flanges	Bolted flange connections
Manufacture and workmanship	Jacketed connections and internal structures
Inspection	Heat treatment
	Welding and radiographic examination
	Protective devices

New in this edition are the appendices 'Tentative recommended practice for vessels required to operate at low temperatures' and 'Examples illustrating the application of the formulae and rules in this standard.'

Copies of this standard are obtainable from British Standards Institution, 2 Park Street, London W.1 Price 40s. (Postage extra to non-subscribers.)

New B.H.C. Booklet on Grangemouth Chemicals

THE NEW booklet 'British Hydrocarbon Chemicals Ltd., 1958' describes the production and applications of the petrochemicals made at Grangemouth by the company and its two subsidiaries, Forth Chemicals Ltd. and Grange Chemicals Ltd. The text is illustrated by 12 photographs and two charts showing the relation of B.H.C. to its parent and associate companies and the general scheme of Grangemouth production.

The description of Grangemouth developments since the company was formed in 1947 is brought up to date by reference to the new polythene ('Rigidex Polyethylene') and phenol plants to be commissioned in 1959 and to the third ethylene unit which on completion in 1960 will be the largest outside the U.S. Copies can be obtained from B.H.C., Devonshire House, Mayfair Place, W.1.

Film Balances Criticised at First Meeting of New S.C.I. Group

INAUGURAL paper at the recently-held first meeting of the Surface Activity Group, Society of Chemical Industry, was given by Professor N. K. Adam, lately of Southampton University, and an eminent authority on surface activity. His paper was entitled 'Some properties and applications of monomolecular surface films' and was mainly an historical review of the work on insoluble monolayers in which he had played an important part.

Professor Adam was critical of film balances in which the pressure measuring barrier was fixed rigidly to the nearly vertical rods attached to the torsion wire. The apparent surface pressure could then be affected by change of level of liquid in the trough. This did not occur if the barrier floated on the surface and the vertical rods fitted loosely through holes in the barrier, or if a very thin, flexible connection was provided. He felt that not enough attention was paid to ensuring that films were completely spread and hoped that the dark ground illumination would be more widely used, particularly with monolayers of high polymers, which often spread incompletely.

New techniques were needed in this field and he mentioned the investigations of Pankhurst on tanning protein films by measuring surface viscosity; and of Bangham and Dawson on enzyme reactions at surfaces, using radioactive tracers either in the monolayer or in the substratum.

In the discussion period, Dr. J. L. Moilliet asked what Professor Adam thought of the so-called 'PLAWM' trough for determining force-area curves of soluble surface-active compounds. If it could be established it would, he said, be of immense value in industry, since it would no longer be necessary to work with highly purified substances.

Professor Adam said that the use of a trough with a very flexible membrane separating the surface with an adsorbed film from a surface of clean water seemed in principle a possible method for measuring the force, or surface pressure. He was not clear how areas per molecule of soluble, adsorbed substances could be measured by this means and did not think the method had been at all widely used, or could easily be used.

Mr. A. Roylance asked if the calculation of the molecular areas of ionised substances in surface films by use of surface-tension concentration curves was complicated by the electrical energies involved. Professor Adam said that Guggenheim, Davies and Pethica had all discussed whether a factor x should be included in the Gibbs adsorption equation for ionised surface-active electrolytes and he was not sure whether a final conclusion had yet been reached, whether x should be 1,2, or some other figure.

Letters to the Editor

'Polymers are Incompletely Defined Synthetic Organic Chemical Compounds'

SIR,—The CHEMICAL AGE has performed a valuable service to the chemical community in reporting at considerable length the proceedings of the polymer arbitration tribunal. In view, however, of the general trend of the leading article on this subject in your issue of 6 December, and of the report of an interview with Mr. Delafield and Sir Miles Thomas, I feel that greater emphasis should be laid on the fact (recognised as you report by the I.C.I.) that the Tribunal's function was only to decide a question of classification. It had to decide whether the four polymers fell within the general description 'all synthetic organic chemicals' . . . . in the Schedule to the Safeguarding of Industries Act, 1921, and consequently whether or not these four articles were such that the Board of Trade ought to have acceded to a request that they be placed on the list of chemicals liable to Key Industry Duty.

The general question as to whether particular industries should be given more protection was not for consideration, but it may be pointed out that at any time since 1932 the industrialists had the right to apply for increased protection under the Import Duties Act, 1932.

You quote in your current issue the rhetorical question put by Mr. P. Delafield and Sir Miles Thomas: 'If the four polymers are not "synthetic organic chemicals" what on earth (or in heaven) are they?"' Surely the answer is that these polymers are complex mixtures of incompletely defined synthetic organic chemical compounds (which have not been isolated); in other words they are complex synthetic organic chemical *materials* but *not* synthetic organic chemicals.

Yours faithfully,
P. MCGREGOR.

75 Oakfield Road,
Southgate,
London N.14.

Will

MR. CHARLES DAVID SYKES, O.B.E., former director of Albright and Wilson Ltd., who joined the firm in 1898 as an assistant research chemist and who became works manager, died on 21 June last, aged 83 years, leaving £120,231 net.

Chemist's Bookshelf

PHYSICS OF RUBBER ELASTICITY

THE PHYSICS OF RUBBER ELASTICITY. By *L. R. G. Treloar*. 2nd Edition. Oxford University Press, London. 1958. Pp. 343. 40s.

The basic concepts of the statistical-thermodynamic theory of rubber elasticity have remained largely unchanged during the past 20 years. This period has, however, seen increasing progress in their use and development which, with the accumulation of new and relevant experimental data, has necessitated the complete revision and rearrangement of the first edition.

As before, the term 'rubber' is used in a wide sense to include polymers exhibiting the property of large elastic extension. The first chapter is a discussion of the general physical properties of such substances. This is followed by a lucid account of the thermodynamics of elastic deformation which leads to consideration of the statistical properties of the single chain and its elasticity, based on the Gaussian distribution function for the single polymer chain. Networks of long chains are then treated by statistical methods in order to quantitatively represent the mechanical properties of bulk material. The limitations of such treatments are discussed and deviations from predicted stress-strain relationships are considered in two separate chapters, the first of which includes a more accurate non-Gaussian theory accounting for deviations at very large strains. The second deals with deviations at moderately large strains in terms of a phenomenological theory of large elastic deformation.

A new chapter on swelling phenomena includes a clear outline of polymer-solvent interaction theory and considers the dependence of swelling on strain. Another new chapter on the estimation of the degree of cross-linking includes recent methods of estimation. Chapters on photo-elastic and dynamic properties have been extensively modified and include consideration of the effects of such factors as molecular weight, chain structure and cross-linking on stress-optical coefficients. Resonance phenomena and methods of studying them are also discussed. A chapter on stress relaxation and flow considers methods of measuring flow in rubbers, the viscosities of polymers and stress relaxation phenomena.

Although treatment is largely theoretical and, inevitably, often mathematical, care has been taken to explain basic concepts and methods. There are many clear diagrams. Experimental methods are given in reasonable detail and the references and indices are adequate. The main object of the book—to present the statistical theory so that its underlying concepts can be readily grasped and to show how this theory provides a natural interpretation of the main physical phenomena associated with rubber-like materials—has been fulfilled. Much of the text is applicable to polymers generally and the book will be of interest to all polymer physicists and chemists. It will be of particular value not only to both the research physicist and physical chemist concerned with rubbers but also to the rubber technologist interested in the interpretation of the properties of his working material.

W. R. MOORE.

Petroleum Chemistry Advances

RECENT ADVANCES IN PETROLEUM CHEMISTRY AND REFINING, Vol. I. Edited by *K. A. Kobe* and *John J. McKetta Jr.* Interscience Publishers, Inc., New York and London, pp. xv + 641, $13.50.

This is the first of a review series to be published each year and covering the broad field of the petroleum and petrochemicals industry. The authors are guided by a highly qualified advisory board and the list of contributors to this volume leaves no doubt that it is intended to be a reference work of considerable authority.

The reviews have been divided into five groups to cover the industry, namely (1) economics and future trends; (2) unit operations and design; (3) refining processes; (4) petrochemicals, and (5) mechanical equipment. This breakdown seems well suited to the scope of the book.

In the first group an excellent review of petroleum operations in the US provides, in the relatively short space available, a wealth of statistical and economic data to illustrate the structure of the industry. Closely allied to this, the next chapter deals with sources and compositions of crude oil in the US and stresses the often overlooked principle that despite the development of cracking and reforming processes the profitability of oil refining is greatly improved by the proper choice of crude oil. A review of fuel trends takes account of the longer term effects of cheap nuclear power as well as discussing shorter term trends in fuel types and qualities.

In the operations and design section, three processes are very fully reviewed, namely separation and purification by crystallisation, superfractionation and extractive distillation, and fractionating tray design. The section on refining processes is topical in reviewing alkylation, catalytic reforming and solvent refining; all three being currently of great interest.

In choosing the oxo process as the first subject in the petrochemical section, the editors are perhaps unfortunate since this has been the subject of a recent more extensive review. However, the authors have provided a reasonably comprehensive although brief account of the subject. In the section on solid polymers from surface catalysts it is to the great credit of the authors that they have been able to review such a broad and complex subject and produce a well composed and readable survey. Some of the immense possibilities in the future for the stereospecific polymers are touched upon.

Finally, in the fifth group there is a most enlightening discussion on power plants in the future.

H. P. HODGE.

Organic Chemistry a Practical Subject

TEXT BOOK OF ORGANIC CHEMISTRY by *Carl R. Noller*. 2nd Edition. W. B. Saunders Co. Ltd. Pp. 600. 49s.

The biggest alkane known of confirmed structure is $C_{100}H_{202}$. Hexamethylethane melts at 100.6° and boils at 106.3°. α-Furfuryl mercaptan, one of the volatile compounds produced when coffee is roasted, smells strongly of onions when present in high concentration, but in high dilutions is employed in making perfumes and flavourings.

These three unusual facts, selected from the many which cram the 600 pages of this second edition of Noller, help to remind us that organic chemistry is essentially a practical subject, to be studied in nature and in the laboratory. There is throughout strong emphasis on the uses and applications of this branch of chemistry, and there are some illuminating references to contemporary American industrial practice.

Vigorous attempts have been made to keep abreast of the numerous developments which have occurred in organic chemistry since the first edition appeared in 1951. A great deal of new material has been incorporated, including ferrocene, inclusion compounds, oxytocin and organic compounds of boron and aluminium.

The new Noller, however, is far more than a mere fact book. The author never loses sight of such important fundamental principles as the determination of formulae from analyses; isomerism and stereoisomerism; organic reaction mechanisms; the relations between structure and physical properties.

A most unusual feature of the work is the inclusion of a large number of miniature biographies of organic chemists.

This happy fusion of the academic, the technical and the human and cultural aspects of the subject has produced a very attractive work, which will interest organic chemists of Inter. standard or above.

KENNETH STUART.

Henry Armstrong, a Founder of Chemical Engineering

HENRY EDWARD ARMSTRONG 1848-1937. By *J. Vargas Eyre*. Butterworth Scientific Publications, London. 1958. Pp. xix + 325. 30s.

'If we cannot be one of the saints of knowledge, be at least one of her warriors!' commanded the poet-philosopher Nietzsche. Henry Edward Armstrong's purely scientific achievements, while very considerable, do not place him with the 'saints' of his science. He was not of the rank of Liebig, Bunsen, Fischer, or Willstätter; he opened up no extensive field of synthesis and no illuminating generalisation bears his name. Many of the views Armstrong held have long ago been proved in error. It is as a warrior of scientific knowledge that Armstrong takes his surest place in the history of British chemistry. He was one of the first to take his bearings in that no-man's land that century-long had lain between academic science and empirical technology. While Dr. Vargas Eyre claims too much when he gives Armstrong 10 years' priority over George E. Davis as a founder of chemical engineering, there can be no doubt that the revolutionary courses of instruction given by the former at Finsbury and South Kensington were a great, if not the greatest, creative contribution to establishing the practical science without which physics and chemistry could not leave the researcher's bench.

Born in 1848, Armstrong died as recently as 1937. His life-span covered the entire era of the development of modern theoretical and technical chemistry. His first brief studies under the departing Hofmann and then Frankland at the Royal College of Chemistry began before the theory of molecular structure illuminated the great field of organic chemistry, and when the periodic law was a controversial novelty recently come from St. Petersburg. It was precisely because he had, so to speak, grown up with it, that Armstrong was able to view chemistry as a systematic whole: he was, indeed, probably one of the last chemists of eminence with both the background and ability to do so.

Armstrong fought his battle for effective dissemination of scientific knowledge on a number of fronts, of which the school and technical college were the principal. The account which Dr. Vargas Eyre gives of Armstrong's experimental work in education and of the heuristic method of teaching by prompted and guided 'discovery' will be of absorbing interest to many not primarily concerned with chemistry.

So well has Dr. Vargas Eyre done the main part of his task that it seems churlish to complain that he has not completed it by the inclusion of an index. All who like to read of men of individuality, imagination and high purpose will be glad that the author—to echo Dr. Linstead, who writes the Foreword—'snatched Henry Armstrong back from obscurity before it was too late'.

D. W. F. HARDIE.

Chemist's Bookshelf

INTRODUCTION TO ELECTROCHEMISTRY

ELECTROCHEMICAL PROCESSES IN CHEMICAL INDUSTRIES. By *Albert Regner*. Translated from the Czech edition. Artia, Prague. 1957. Constable and Co. Ltd. Pp. 464. 30s.

Definition of the limits of 'Chemical industries' is subject to various interpretations. As used in the title of this book, it does not include processes which might also be classified as electrometallurgical, and consequently industrially important fused melt processes for the electrolytic production of metals such as aluminium, magnesium and sodium, are omitted. On the other hand, purely chemical processes such as the nitrosyl chloride process for chlorine, and the chemical processes for hydrogen peroxide, which are possible alternatives to electrolytic processes, are included. Following well established precedents the first half of the book describes electrochemical theory, and the latter part the industrial applications. The theoretical discussion of 'overvoltage' is exceptionally concise. More than half the space used to describe processes is allocated to chlorine and chlorine compounds. Processes for the electrolysis of water and the production of hydrogen peroxide are described in some detail, while fluorine cells, and some other minor processes, receive attention.

References to recent work in scientific and technical journals are not made, and although industrial information is presented with an international outlook, some inaccuracies such as 'The Mathieson Alkali Works at Arvida' appear.

Latest developments with germanium and silicon rectifiers might not yet be expected to be included in the chapter on 'Sources of Direct Current', but an account of the process of solidification of caustic soda, without mention of continuous Dowtherm evaporators, now seems inadequate. The description (with diagrams) of a Hooker diaphragm cell, which include coils for heating the brine and cooling the caustic liquor, gives no indication that this is an unusual modification to the standard designs of either the original type S or the more recent type S-3B. Although some constructional details are included of horizontal mercury cells, the major differences between leading modern designs are not identified, and no information of interest is given on developments of the mercury cell process which has not previously been published in English. On p. 197 reference is made to a tendency not to exceed a maximum of 400 volts in an electrolytic circuit, although it is also stated (p. 287) that mercury cells are operated in 'series of up to 20 cells . . . . with a voltage of 900 V'.

For a technical student the book gives both the basic electrochemical theory and a useful introduction to the electrochemical processes that have been selected. The extent of technical detail is in some instances considerable, but as may be expected from a book of this scope, an industrial electrochemist designing a new production plant would find the information to be a considerable over-simplification of his problems. Although the English is sometimes slightly stilted, the clarity of meaning is good. The numerous diagrams (which include a cell for high pressure electrolysis of water 'designed by Soviet technicians'), are, with very few exceptions, readily intelligible. At 30s. (paper covers) the book is good value, and is a useful addition to the literature.

C. M. TUBB.

Analytical Methods for Trade Effluents

RECOMMENDED METHODS FOR THE ANALYSIS OF TRADE EFFLUENTS. Prepared by a *Joint Committee of the Association of British Chemical Manufacturers* and the *Society for Analytical Chemistry*. W. Heffer and Sons, Ltd., Cambridge. 1958. Pp. xii + 124. 42s.

The non-existence of officially approved methods for the analysis of trade effluents in this country is the motivating force behind the publication of this booklet. The problem has been a pressing one for some time, but the passing of the Rivers (Prevention of Pollution) Act in 1951 necessitated definite action. Methods for the analysis of sewage-works effluents cannot cope with the complexity of materials present in many trade effluents, but this new collection of recommended methods should go a long way towards solving many of the major problems.

Beginning in workmanlike fashion, the book deals first with the basic problem of sampling of effluents and it gives working details for the use of an approved sampling device together with practical hints on the storage of such samples. The preliminary examination of the sample, from which much valuable information is obtained, is dealt with next. Recommended procedures are detailed for estimating: pH, total acidity or alkalinity, water hardness, transparency, dissolved and suspended solids and volatile non-miscible organic liquids.

Analytical methods are recommended for the following metals: Al, Sb, As, Ba, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Ni, K, Se, Na and Zn. Many of these methods depend on the extraction of the metal chelate of an organic reagent by a water-immiscible solvent and the subsequent

use of a spectrophotometer to determine the optical density of the extract. Analytical methods are recommended for non-metals, e.g. chlor ion, residual chlorine, organic carbon, cyanide, thiocyanate, fluoride, formaldehyde, phenols, phosphorus, combined sulphur, detergents (cationic, anionic, non-ionic, cation and anion active material in admixture) and the various forms of combined nitrogen (ammoniacal, albuminoid, organic, nitrite, nitrate and total 'unoxidised' nitrogen). Another section of the book deals with the important matter of oxygen demand and an appendix is given on flame-photometry. The latter conveys little essential information in its brief one-page coverage and it is difficult to envisage the reason for its inclusion.

As is to be expected in a book of this kind, the recommended methods are based on sound classical procedures—mainly titrimetric and absorptiometric—but little hesitation has been shown in taking advantage of new separation techniques such as ion-exchange, newer reagents such as disodium ethylenediamine tetra acetate and, as already inferred, modern trace techniques, e.g., flame photometry. It is not easy to assess how long the methods will stand (e.g., some may shortly require replacement by others, viz., the benzidine method for cyanide and thiocyanate) and it is highly probable that the drift towards instrumental methods will make itself felt in this field as elsewhere. However, be that as it may, there is no doubt that the joint committee of the A.B.C.M. and the S.A.C. have rendered a valuable service to analytical chemists, and indirectly to the citizens of the U.K., in producing this first collection of recommended methods. They are also to be congratulated in having produced it so very quickly and efficiently.

T. S. WEST.

Reference Work for Analysts

PROCEEDINGS OF THE CONGRESS ON MODERN ANALYTICAL CHEMISTRY IN INDUSTRY. The University of St. Andrews, June 1957. Prepared by the Society for *Analytical Chemistry*. W. Heffer and Sons Ltd., Cambridge. 1958. Pp. vii + 244. 42s.

Now available in book form are the proceedings of the congress on modern analytical chemistry in industry which was arranged by the Scottish section of the Society for Analytical Chemistry. It will be recalled that the papers were summarised in CHEMICAL AGE in June and July 1957 during the congress, together with discussion and other reports. The proceedings as now published are divided into three main parts: analysis in modern industry; application of some newer analytical techniques in industry; and developments in analysis for new problems in industry. The lectures were given by well-known analytical chemists. During the congress, three special congress lectures were delivered: by Dr. J. Craik, chairman, Nobel Division, Imperial Chemical Industries Ltd., by Dr. E. B. Hughes, chief chemist, J. Lyons and Co. Ltd.; and Professor G. F. Smith, Emeritus Professor of Chemistry, University of Illinois.

There is much in this record of the St. Andrews congress of interest to all analytical chemists. At the time of the congress many who wished to attend were unable to do so because of lack of space. To these and to all who wish to refer to developments of modern industrial analysis, these proceedings should prove to be a handy reference work. D.L.M.

Ramsay Dinner's Leading Light Fogbound

ANNUAL dinner held in Glasgow in memory of Sir William Ramsay took place on 4 December. Unfortunately, due to a fog, Marshal of the R.A.F., Lord Douglas of Kirtleside, was unable to travel north to propose the toast of the 'Profession of chemistry'. He was, however, able to send his speech by teleprinter to Glasgow and it was read for him by Mr. D. S. Wilson, convener of the dinner.

In his speech, Lord Douglas admitted that he was a classics scholar, but said that there was no doubt that aviation owed much to the chemist. He felt that there were now greater opportunities than ever before for the chemist to lead the way—for example, the jet engine was still in its infancy and it might well be that the next important step was to wean this infant from good old-fashioned paraffin fuel on to some entirely new diet giving far greater efficiency.

Chairman of the dinner, Professor H. J. Emeleus, president of the Chemical Society, in replying to the toast, pointed to Ramsay as an inspiration and an example to the profession.

Dr. Magnus Pyke, chairman, Scottish section, Society for Analytical Chemistry, proposed the toast of the 'City of Glasgow' from the vantage point of an Englishman resident in Alloa. The Lord Provost of Glasgow, Mr. Myer Galpern, in his reply referred to the historical and present day connections that Glasgow has with both academic and industrial chemistry and mentioned in particular the early industrial applications of chlorine compounds by Tennant and the manufacture of dyestuffs in the city.

Dr. David Traill, research director, I.C.I. Nobel Division, proposed 'The Guests,' regretting the absence of Lord Douglas and of Professor Wardlaw, president, Royal Institute of Chemistry. Professor C. H. Gray, vice-president, R.I.C., replied for the guests.

Before dancing began, Dr. W. A. Caldwell, chairman, Glasgow section, R.I.C., called for a vote of thanks for the Chairman.

Other guests at the dinner were: Dr. A. K. Mills, vice-president, Society of Chemical Industry, and Dr. James Craik, chairman, Glasgow section, S.C.I.

Limitations of Synthetic Fibres usage in Rubber Industry

DIFFICULTIES of adhesion are the principal drawback to the use of synthetic fibres in the rubber industry, stated Mr. R. S. Goy of the Dunlop Research Centre, when he addressed a meeting of the north-east section of the Institution of the Rubber Industry at Newcastle recently. Although many of the new man-made fibres were superior to cotton by virtue of their high strength and good heat resistence, he said they nevertheless had their limitations. However, in the case of tyres, adhesion could be assisted by the use of chemical methods. One of these was the application of an aqueous solution of resorcinol formaldehyde resin and latex, the latex being either natural, or one of the synthetic rubbers such as S.B.R. or vinyl pyridine terpolymer. Another was isocyanate treatment usually in the form of a solvent solution mixed with rubber. Belting and hose manufacture presented a more intractable problem owing to the difficulty experienced in getting sufficient penetration and the long and expensive drying times required by the thicker fabrics used.

C.A. Report of Polymer Tribunal

Because our 20-page report of the proceedings of the polymer tribunal will be the only record of what transpired, apart from the official transcript, it will be reprinted if there is sufficient call for reprints. These will cost 2s. 6d. each, with bulk supplies at 2s. each for 12, 1s. 9d. each for 24 or more. Readers who would like to receive copies are asked to inform the Editor, *Chemical Age*, 154 Fleet Street, London, E.C.4, as soon as possible

B.o.T. to Ease Duty on Scientific Instruments

IN a written Parliamentary reply, Sir David Eccles, president of the Board of Trade, stated that he was proposing to widen the scope of the arrangements for remitting duty on optical and scientific instruments and apparatus. The B.o.T. will be prepared to consider applications in respect of all instruments and apparatus imported on or after 1 January which are covered by the definition in the Import Duties Act, 1958, where the rate of duty is 25%, or more and the amount of duty chargeable is £50 or over.

Duty may be remitted on the following instruments and apparatus, if similar articles are not for the time being procurable in the U.K.: optical and scientific instruments and apparatus; measuring and checking instruments and apparatus; apparatus based on the use of X-rays or of the radiations from radioactive substances; thermionic, cold-cathode and photo-cathode valves and tubes; discharge lamps.

Overseas News

ITALIAN PLASTICS INDUSTRY'S NINE-FOLD INCREASE IN EIGHT YEARS

ACCORDING to Dr. Mario L. Ottolenghi, vice-president of Chemore Corporation, U.S. representative of Montecatini, the Italian chemical and plastics manufacturers, consumption of plastics in Italy has climbed from 28 million lb. in 1950 to 244 million lb. in 1957, a ninefold increase in eight years.

Speaking at Society of the Plastics Industry Inc.'s 8th National Plastics Conference held in Chicago recently, Dr. Ottolenghi observed that Italian consumption increase per year of plastics products was now more than 13% as compared to a recent increase of about 7% annually in the US. However, per capita consumption in Italy was still about 5 lb. as compared to 25 lb. in the U.S.

Italian plastics production in 1957 was higher than consumption by 33 million lb. Italy exported some 66 million lb. of plastics annually and imported some 33 million lb. The Montecatini group accounted for some 50% of the country's total production.

Reviewing the various types of plastics produced in Italy, Dr. Ottolenghi noted that in the thermosetting field some half dozen producers accounted for 21,000 tons of melamine and urea and about 14,000 tons of phenolics annually. Largest volume group of resins in Italy were currently the vinyls with a production level in 1957 of 54,000 tons, 48,000 tons of which were p.v.c. A great amount of this p.v.c. was rigid, unplasticised material.

Polythene consumption in Italy in 1957 was of the order of 9,000 tons and with the expiration of I.C.I.'s patents a number of new manufacturers were expected to enter the market. Polythene, however, was already meeting competition from Montecatini's new isotactic polypropylenes. This plastic was expected to find uses peculiarly its own that would take advantage of its high heat resistance, good dielectric properties, light weight, rigidity, excellent chemical resistance. In addition, it would compete with resins of similar price such as polythene and with those higher in price like nylon and cellulose butyrate.

West German Nitrogen Production

In what the German Society of Chemical Industry calls the fertiliser year 1957/58 (July 1 to June 30) the West German chemical industry produced 1,210,000 metric tons of nitrogen. Of this total, all but 160,000 metric tons went for processing into artificial fertilisers. This total of 1,050,000 metric tons of nitrogen for fertiliser industry showed the greatest annual increase yet experienced by the country's industry—one of 17%—on the 1956/57 figure of 898,000 metric tons. Despite sharp international competition, exports of nitrogen fertilisers rose, the 1957/58 total of 466,851 metric tons being 102,000 metric tons above the previous year's totals. In the past five years the share of exports in the overall production has risen from 30.4% to 45.2%.

With the low domestic price for nitrogen, the German industry looks forward to a further extension of fertiliser production on the home market. On the Continent only Holland, with a price of 1s 10d per kilogramme of nitrogen, has a price lower than that current in West Germany (2s 1½d). Other countries' prices for 1 kg. nitrogen are: France, 2s 3d; Italy, 2s 3½d; and Belgium, 2s 4d.

Ethylene Urea Available for First Time from U.S. Firm

Ethylene urea in pure form has been made available in commercial quantities. It is a colourless and odourless neutral solid which is easily and clearly soluble in water, methanol, ethanol, etc.

Large scale tonnage production facilities for this pure chemical are being completed according to a new and unique manufacturing and purification process at the Metro-Atlantic, Inc. plant at Centredale, Rhode Island, U.S. It is marketed by Baird Chemical.

This is the first time that this cyclic urea is made available in pure dry form on a commercial scale to the synthetic organic chemical industry, the textile industry, and to resin manufacturers. Further information is available from Baird Chemical, 10 West 33rd Street, New York.

Plastics and Rubber Production in Eastern Germany

In the first half of this year Eastern Germany produced 41,301 metric tons of synthetic rubber, it has been announced. This contrasts with an output of 36,754 metric tons during the same period of 1957. Also produced in the 1958 period were 26,959 metric tons p.v.c. powder (24,905 metric tons) and, with the largest increase of all, 3,676 metric tons caprolactam (2,942 metric tons).

Production of plastics is to be brought up to 300,000 metric tons annually by 1965. The development so far in annual production of the main groups and that planned for the future are shown below.

East German Plastics Production

(Figures in metric tons)

	1956	1958	1960	1963	1965
Polyvinylchloride	46,000	54,000	60,000	100,000	120,000
Polystyrene	2,600	3,400	3,600	15,000	20,000
Polyamide	1,200	—	1,600	4,000	6,000
Polyvinyl acetate	—	—	6,000	10,000	12,000
Phenolic resin (unfilled)	—	—	16,000	—	35,000
Aminoplastics	8,700	—	32,000	40,000	50,000
Misc. polyesters	—	—	—	4,000	5,000
Polythene	—	—	1,000	—	up to 50,000

(Blanks do not necessarily mean that the product is not being manufactured)

Iran's New Fertiliser Plant

Montecatini are to co-operate with the Anglo-French company, ENSA, (in which John Brown, Schneider and Entrepose are represented) in building the first fertiliser plant to operate in Iran. Capacity of the new plant is being scheduled at 90,000 tons of ammonia nitrate a year. The cost will be equivalent to $29.5 m.

Brazilian Companies to Produce Styrene and Polystyrene

Two Brazilian chemical producers, Cia. Brasileira de Estireno and Bakol S.A. Indústria e Comércio, both of Sao Paulo, are soon to start production of styrene monomer and polystyrene. Quimica Industrial Huels do Brasil Ltda., a 100% subsidiary of the West German Chemische Werke Hüls A.G., hold an interest of 20.5% and 49.5%, respectively, in the two companies.

Fire Damages Wyandotte's New Ethylene Oxide Plant

An as yet undetermined amount of damage has been caused at Wyandotte's new $11 million ethylene oxide plant at Geismar, Los Angeles (see CHEMICAL AGE 25 October, p. 689), by fire. The fire occurred in the recycle product gas cooler situated before the reactors.

Degussa May Enter Beryllium Field

As soon as Degussa are satisfied that there is a sufficiently high demand they will start the production of high-purity beryllium and beryllium oxides. Raw material in a more than sufficient quantity is available for this purpose.

U.S.S.R. Caprolactam Plant

In the Ukranian synthetic fibre plant of Kiev the first installation for the continuous polymerisation of caprolactam has been set into operation. The whole process of manufacture of caprolactam, which previously took four days, now takes only 36 hours, it is reported.

Solvay Group's Spanish Interest

The Belgian Solvay Group has been authorised by the Spanish authorities to contribute, from the transferable funds of its Spanish subsidiary, 43.75 per cent of the capital of a new venture, Hispanic Industrial S.A., formed with the object of manufacturing polyvinylchloride and its derivatives.

Commercial News

• Reichhold Propose One-for-three Issue
• S.A.I. Special Interim on Doubled Profit
• £5.9 m. Net Profit for Turner & Newall
• United Indigo's Plan Opposed

Reichhold Chemicals

Reichhold Chemicals Ltd. have decided that as soon as the formalities can be completed they will submit to the shareholders proposals for capitalising £156,467 through the issue of one fully paid ordinary share for every three fully paid ordinary shares at present held.

The group's profits for the first nine months of 1958 exceed those for the corresponding period of 1957. The directors expect that, in the absence of unforeseen circumstances, the 1958 profits will enable them to recommend, in due course, that the final dividend be maintained at 12½% on the increased capital.

S.A.I.

Sales of Scottish Agricultural Industries (who are controlled by Imperial Chemical Industries Ltd.) for the year totalled £23,658,882 (£22,741,476) and profits rose to £1,235,062 (from £622,862) before tax of £658,046 (£294,762).

Ordinary dividend is being held at 8% with a final payment of 5%. In addition the board have declared a special interim of 2%, payable with the final dividend, in respect of 1959.

Turner and Newall

Consolidated trading profits of Turner and Newall Ltd., manufacturers of asbestos, magnesia and allied products, contracted from £12,873,321 to £11,727,116, after depreciation of £2,715,252 (£2,752,728). With increased investment income, lower charges and tax provision, group net profit, however, is some £116,000 higher at £5,973,524 against £5,857,229.

A final dividend of 10% is to be paid, making a 15% total for the year ended 30 September 1958. There was a similar equivalent for 1956-57 when there was a one-for-one scrip issue between the interim and final payments.

United Indigo

In his annual statement, Mr. William S. Heywood, chairman of United Indigo and Chemical Co., declared that three courses were open to the company, which last year incurred a net loss of £5,639 and carried forward a deficiency of £3,908 (see CHEMICAL AGE, 29 November, p. 913). The first was to go into liquidation, the second to distribute a proportion of surplus cash resources and carry on with internal organisation of centralisation and concentration, and thirdly to go into new lines. He also reported that Mr. Dohm, a newly appointed director of the company, had proposed a close link-up with his own private company, which had a large sales force with export connections in a similar and non-competitive field of activities. This proposal had met, stated Mr. Heywood, with the approval of a group of shareholders controlling a large block of shares.

Opposition to the above plan to merge with Mr. Dohm's company is now being organised by a holder of preference and ordinary shares, a Mr. F. F. Farage, who has circularised shareholders urging them to vote against the re-election of Mr. Dohm to the board and the proposed appointment of two new directors.

I.C.I.A.N.Z.

Profit of Imperial Chemical Industries of Australia and New Zealand jumped £A529,000 to a record £A2,720,000 in the year to 30 September 1958. The ordinary dividend is being maintained at 9% with a final of 5½%.

LONDON GAZETTE

Voluntary Winding-up

(Notice of a company voluntarily winding-up is purely formal. It does not imply insolvency.)

VICTORIA CHEMICAL CO. LTD., chemical merchants, reg. office, St. George's Road, New Mills. By special resolution, 26 November. Mr. A. Popplewell and Mr. J. Smalley, 48-50 Mosley Street, Manchester 2, appointed liquidators.

Winding-up Order

DYNE CHEMICAL WORKS LTD., reg. office, 31 Hamilton Court, Maida Vale, London W.9. By order, 1 December. Petition presented 12 November.

Market Reports

OVERSEAS ENQUIRY 'MODERATELY GOOD'

LONDON There has been little of fresh importance to report on the industrial chemicals market with the movement to the chief home consuming industries maintained at a steady level. Increasing attention is being given to the renewal of contracts, but buyers are still hesitant to cover their needs for more than 3-months ahead. Overseas inquiry has been moderately good under competitive conditions. Prices in most sections remain firm, and the only movement has been among the non-ferrous metal compounds where the zinc oxides are again dearer.

Agricultural chemicals are seasonally quiet and, as with other sections of the market, business is not expected to show signs of expansion until the new year. Activity in coal tar products continues steady with interest mainly centred on contract renewal quotations; it is understood that no price changes are expected.

MANCHESTER Prices on the Manchester market for heavy chemicals during the past week have maintained a steady undertone and actual changes since last report have been few. The most important has been a reduction in sulphate of copper to the extent of £4 a ton, bringing the current quotation to £74, f.o.b. Liverpool. Contracts are mostly being drawn against fairly well, with new home-made bookings on a moderate scale. Export business keeps up at about its recent level.

GLASGOW A fairly active week's trading was enjoyed on the Scottish heavy chemical market, with quantities well up to normal requirements. Materials demanded covered a range of chemicals and a volume of inquiries were received. Attention is now being focussed on contract needs over next year. Prices have more or less remained firm with the exception of metal derivatives. Agricultural chemicals are still seasonably quiet, while the overseas market continues at a good level.

DIARY DATES

MONDAY, 15 DECEMBER

S.C.I.—Leeds: Hotel Metropole, 7 p.m. 'High temperature microscopy in chemical research' by J. H. Welch.

TUESDAY, 16 DECEMBER

Inst. Industrial Safety Officers—Manchester: 16 Queen Street, 6.30 p.m. 'Detection of chemical hazards in industry' by W. M. Diggle.

Inst. Metals—Swansea: University College, Singleton Park, 6.30 p.m. 'Properties of metals at very low temperatures' by J. E. Aubrey.

Inst. Metals, Iron & Steel Inst.—London: Church House, S.W.1., 6.30 p.m. & 9.30 a.m., 16 December. Symposium on powder metallurgy of ceramic-metal materials (oxides, carbides, borides & silicides).

WEDNESDAY, 17 DECEMBER

I.Chem.E.—London: Geological Soc., Burlington House, 5.30 p.m. 'Liquid distribution in grid packings' by J. W. Mullin.

Inc. Plant Engineers—Rochester: Kings Head, High Street, 7 p.m. 'Treatment of trade effluents & methods of purification' by T. Waldmeyer.

Inst. Metal Finishing—Birmingham: Engineering Centre, Stephenson Place, 6.30 p.m. 'Polyester finishes, have they a future?' by B. M. Letsky.

O.C.C.A.—London: 28 Portland Place, W.1, 7 p.m. 'Reactions of drying oils with hydrocarbons' by E. F. Redknap.

R.I.C.—Manchester: College of Science & Technology, 2-8 p.m. & 18 December, 10 a.m. to 8 p.m. Exhibition of chemical laboratory apparatus & techniques.

S.A.C.—Birmingham: University, Edmund Street, 6.30 p.m. 'Flame photometry' by L. Brealey.

FRIDAY, 19 DECEMBER

S.D.C.—Manchester: 10 Blackfriars Street, 7 p.m. 'Felisol—an international guarantee of colour fastness' by K. McLaren.

S.A.C. with R.I.C. & S.C.I.—Cardiff: University College, 7 p.m. 'Recent trends in qualitative analysis' by D. W. Wilson.

S.C.I.—London: 14 Belgrave Square, S.W.1. 2.30 & 5.30 p.m. 'Modern views of electrochemical processes'—cathodic by E. C. Potter, anodic by T. P. Hoar.

A night scene at the plant

Hydrogen Peroxide Plant

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The new hydrogen peroxide plant now in operation at the Warrington works of Laporte Chemicals Limited marks another milestone in the history and technical achievements of the Laporte Group.

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PEOPLE in the news

● SIR ALEXANDER FLECK, I.C.I. chairman, who left for Australia at the end of November to open I.C.I. House in Melbourne, the new headquarters of I.C.I.A.N.Z., is due back in this country this week-end. Australia, with nearly £3 million worth of goods bought, has become I.C.I.'s largest single export market, despite the fact that the total turnover of I.C.I.A.N.Z. is now running at the annual rate of £40 million.

● MR. R. C. DICKIE, M.A., works manager of Marchon Products Ltd., Whitehaven, has been appointed a director. He joined the company in 1946 as chief chemist. MR. O. SECHER, a director of Marchon Products, in charge of sales, has now been appointed to the board of Solway Chemicals Ltd., Marchon's subsidiary company. Both companies are members of the Albright and Wilson group.

● MR. F. C. HYMAS, M.SC., M.R.S.H., elected chairman of the London section, Royal Institute of Chemistry, at the recent annual meeting, is chief chemist of Spratt's Patent Ltd., whose laboratory is at Morris Road, London E.14. Educated at Enfield Grammar School and Birkbeck College, Mr. Hymas graduated at London University in 1923 and was awarded his M.Sc. for work in photochemistry. Formerly wih British Drug Houses, during the war he was chairman of the North London group of the Gas Identification Service. His professional interests are foods, nutrition and insecticides.

● MR. LESLIE INGHAM, formerly manager of the industrial sales division, has been appointed assistant sales manager of Chloride Batteries Ltd., Grosvenor Gardens House, Grosvenor Gardens, London S.W.1, for the sales of all types of batteries in the U.K. and overseas.

Frank Monaghan (centre) who has retired after 39 years in the pigment colour industry and 27 years with Geigy (James Anderson and Co. and the Geigy Co.), was recently entertained to lunch by his colleagues. He received a presentation from Harold Clayton, managing director, Geigy Co. Ltd. (right). On the left is A. H. Whitaker, managing director of James Anderson and Co. (Colours) Ltd.

● MR. HARALD LIST has been appointed an ordinary director of Reichhold Chemicals Ltd., at the request of Reichhold Chemicals Inc. Mr. List is a director of Reichhold Chemie A.G., Hamburg, and of Reichhold Beckacite S.A., Paris. DR. WALTER STRAUS, who has also been appointed an ordinary director, is a founder director of two of the subsidiaries, Vinyl Products Ltd. and Vinatex.

● MR. R. J. DE VRIES has been appointed technical sales manager of Armour Chemical Industries Ltd., 4 Chiswell Street, Finsbury Square, London E.C.1. Before joining Armour in 1955 he worked on ion exchange, the production of synthetic resins, and the application of plastics for corrosion resistance and in civil engineering. During the past four years he has been concerned with the market development of Armour's cationic surface active chemicals in road making, and the paint, textile, laundry, plastics and chemical industries.

R. J. de Vries

● MR. R. H. THOMAS, O.B.E., a member of the National Coal Board, was elected president of the British Tar Confederation at the recent annual meeting. Other officers are: hon. treasurer, L. W. BLUNDELL, controller of by-products, North Thames Gas Board; chairman, SIR HENRY JONES, M.B.E., deputy-chairman, Gas Council; vice-chairman, STANLEY ROBINSON, chairman, Midland Tar Distillers Ltd., and LT. COL. P. F. BENTON-JONES, United Coke and Chemicals Ltd. The following comprise the board for 1958/59: *representing the Association of Tar Distillers*:

L. W. BLUNDELL (North Thames Gas Board), E. P. BUTLER (Bristol and West Tar Distillers), C. E. CAREY (South Eastern Gas Board), E. HARDMAN (E. Hardman, Son and Co.), R. T. HAYES (United Coke and Chemicals), T. L. KINTON (Prince Regent Tar), M. J. R. LANE (Normanby Park Tar Supply), C. LORD (Lancashire Tar Distillers), WM. MCFARLANE (Scottish Tar Distillers), STANLEY ROBINSON (Midland Tar Distillers); *British Coking Industry Association*: LT. COL. P. F. BENTON-JONES (United Coke and Chemica.s), K. MCK. CAMERON (Stanton Ironworks), T. R. CRAIG (Colvilles), C. F. DUTTON (N.C.B.), J. Y. FEGGETTER (N.C.B., Durham Division), C. M. FRITH (South Yorkshire Chemical Works), I. HALL (N.C.B., N.E. Division), W. D. HOLT (N.C.B., E. Midlands Division), A. SLATER (Staveley Iron and Chemical), C. F. SULLIVAN (N.C.B., S.W. Division); *Gas Council*: S. BLACK (Northern Gas Board), R. N. BRUCE (North Thames and Eastern Gas Boards), D. D. BURNS (Scottish G.B.), J. CARR (Southern and S.W. G.Bs.), E. H. HARMAN (E. and W. Midland G.Bs.), W. HODKINSON (N.W.G.B.), W. K. HUTCHISON (S.E.G.B.), SIR HENRY JONES (Gas Council), A. MCDONALD (N.E.G.B.), J. POWDRILL (Wales G.B.); *Low Temperature Coal Distillers' Association*: COMMANDER COLIN BUIST.

W. K. McGavin, who, as stated last week, is the new manufacturing director of Shell Chemical Co.

● To streamline their outside representation Fielden Electronics Ltd., Wythenshawe, Manchester, have formed three new sales divisions; London, the North-East and the Midlands. MR. R. SPELLER, after three years as representative in north London, becomes manager of the London sales division; MR. F. G. TOTTY is North Eastern manager, based on Stockton; and MR. F. B. PRICE assumes the management of the expanding Midlands division.

● MR. K. TARDIF has been appointed home sales manager of G. A. Harvey and Co. Ltd., Greenwich Metal Works, London S.E.7. MR. H. BARKER has been appointed export sales manager and MR. H. F. JONES, the new London area manager will control the London sales office at 58 Victoria Street, S.W.1.

● Four of the executives of Simon-Carves Ltd., Cheadle Heath, Stockport, have joined the board of their recently-acquired subsidiary company, Lodge-Cottrell Ltd. They are MR. J. P. V. WOOLLAM, M.I.CHEM.E., as chairman, and MR. R. B. POTTER, MR. N. HINTON and MR. P. D. TAYLOR, as directors. Three Lodge-Cottrell directors retain their previous appointments: MR. D. H. RICHARDS as managing director, and MR. H. G. TREVOR BUSBY and MR. E. R. WATKINS, as executive directors.

Obituary

DR. ROBERT STEPHEN JANE, president of Shawinigan Chemicals Ltd., Montreal, and chairman of the Canadian section, S.C.I., died recently.

TRADE NOTES

Endecotts to Move

Owing to rising demand, Endecotts (Filters) Ltd. have acquired larger premises which are more than double the size of their existing accommodation. The new building will house both offices and works and from 5 January the company's address will be: Lombard Road, London S.W.19. Telephone number remains: Liberty 8121-2. The company has just published a new general filter folder which describes its activities.

Platinum Laboratory Apparatus

A new publication, No. 1700, dealing with platinum laboratory apparatus has been published by Johnson, Matthey and Co. Ltd., 73-83 Hatton Garden, London, E.C.1. Included are a comprehensive survey of the apparatus and electrodes in the JMC range, and useful advice on care and maintenance. New forms of platinum ware have been developed in view of advances in microchemical analysis.

New Anti-corrosion System

The problem of applying an *in situ* protective lining or sheathing for metals and concrete exposed to unusually severe chemical attack is said to have been solved with the recently developed Tretoprene 2C system. A remarkably high film thickness of 15-20 thousandths of an inch, equivalent to 15 or more coats of paint, is obtained in a two-coat brush application of this protective system (on primed surfaces). The coating is based on a neoprene compound which has an abrasion resistance akin to that of a very tough rubber. Tretoprene 2C system will withstand attack from a wide range of chemicals used in modern industry and is also resistant to salts, mineral and vegetable oils and fats.

Full details of Tretoprene 2C and advice on specialised applications can be obtained from Tretol Ltd., Tretol House, The Hyde, London N.W.9.

Change of Address

The sales department of B. Young and Co. Ltd., gelatine manufacturers, has been transferred from Grange Road, S.E.1, to Imperial House, 15-19 Kingsway, London W.C.2 (telephone: Temple Bar 7777). The company's accounts department remains at 96 Bridge Road East, Welwyn Garden City.

Change of Name

Herbros Ltd., manufacturers of chemicals, gases, drugs, etc., 14 Essex Street, London W.C.2, have changed their name to Herbros Holdings Ltd.

I.C.I. Degreasing Plants

A new standard range of totally enclosed mechanised trichloroethylene degreasing plants (type E) are described in a new booklet available from Imperial Chemical Industries Ltd., Imperial Chemical House, Millbank, London S.W.1, or regional sales offices. The work-handling capacity of the new plants and the choice of treatments available is sufficiently flexible to enable them to deal with a wide variety of industrial metal degreasing problems. The new standard range will ensure speedier delivery.

New Hygrotherm Agents

Problematics Ltd., of 175 St. Vincent Street, Glasgow C.2, have been appointed Scottish agents for Hygrotherm Engineering Ltd., and Mr. M. Buis, of Durantes, Keizersgracht 523, Amsterdam, is now Dutch agent for the same company.

New U.K. Customs Tariff

The new Customs and Excise Tariff, based on the Brussels nomenclature, will be published on 15 December and will come into operation on 1 January. In a blue binding, the new tariff will be easily distinguishable from the advance yellow-bound edition dated June 1958. It incorporates many amendments and additions. It is essential that importers and import agents should obtain copies as soon as possible so that they can correctly enter their goods for Customs purposes on and after 1 January. Priced at 12s. 6d. net, it is obtainable from H.M. Stationery Office or through any bookseller.

Lead Association's Publication

The Lead Development Association has issued the first number of a new quarterly publication entitled 'Technical Abstracts.' It comprises short reviews of relevant information from current literature on lead, including a section on paint. Brief information on new patents is also given. The publication can be obtained from the Association at 18 Adam Street, London W.C.2.

NEW PATENTS

By permission of the Controller, HM Stationery Office, the following extracts are reproduced from the 'Official Journal (Patents)', which is available from the Patent Office (Sale Branch), 25 Southampton Buildings, Chancery Lane, London WC2, price 3s 3d including postage; annual subscription £8 2s.

Specifications filed in connection with the acceptances in the following list will be open to public inspection on the dates shown. Opposition to the grant of a patent on any of the applications listed may be lodged by filing patents form 12 at any time within the prescribed period.

ACCEPTANCES

Open to public inspection 14 January 1959

Organopolysiloxane compositions. Midland Silicones, Ltd. **807 503**

Process for applying a thermoplastic inner lining to pipes made of non-thermoplastic material. Tubovit S.P.A. **807 413**

Apparatus for sampling liquids. U.K. Atomic Energy Authority. **807 414**

Fungicidal compositions and materials. Monsanto Chemicals, Ltd. **807 240**

Anthraquinone dyestuffs. Farbenfabriken Bayer, AG. **807 241**

Preparation of stable, injectable solutions of thiamin orthophosphoric ester chloride. Prod. Farmaceutici Specializzati Dott- M. Calosi & Figlio S.p.a. **807 242**

Mixed polyesters. Imperial Chemical Industries, Ltd. **807 243**

Containers for powdered and granular materials. Amalgamated Limestone Corp. **807 320**

Method for stabilising polyvinyl pyrrolidone and compositions thereby obtained. Dow Chemical Co. **807 455**

Merocyanine dyes and photographic silver halide emulsions containing them. Kodak, Ltd. **807 460**

Supported nickel catalysts. Office National Industriel de L'Azote. **807 358**

Devices for dispensing measured quantities of liquids from bottles. Gaskell & Chambers, Ltd. [trading as Non-Drip Measure Co.]. **807 484**

Production of aromatic nitriles and imides. Distillers Co., Ltd. **807 485**

Reduction process. Imperial Chemical Industries, Ltd. **807 383**

Method for preparing a liquid oxygen explosive. Great Lakes Carbon Corp. **807 487**

Production of diacetals of propargyl aldehyde. Badische Anilin- & Soda-Fabrik AG. **807 247**

Water-soluble polymeric compositions containing polymerised vinylbenzyl quaternary ammonium compounds. Dow Chemical Co. **807 488**

Process for making porous plastic plates and plastic plates so produced. Jungfer, L. [trading as Akkumulatorenfabrik Dr. L. Jungfer.] **807 385**

Method for spinning polyolefins. Dow Chemical Co. **807 248**

Process for separating the elements zirconium and hafnium from one another. Deutsche Gold- und Silber-Scheideanstalt Vorm. Roessler. **807 249**

Sulpho-succinic acid mono amides. Cassella Farbwerke Mainkur AG. **807 257**

Orientation of polyethylene terephthalate film. Du Pont de Nemours & Co., E. I. **807 258**

Ceramic compositions for high power capacitors. Compagnie Generale de Telegraphe Sans Fil. **807 259**

10-[2-(1-pyrrolidyl)alkyl] phenothiazine-N, 5-dioxides. Upjohn Co. **807 260**

Process for the purification of alkaline-earth metals by distillation at reduced pressure. Deutsche Gold- und Silber-Scheideanstalt Vorm. Roessler. **807 493**

Acyl derivatives of 4, 6-dihydroxy-isophthalic acid. Farbenfabriken Bayer, AG. **807 326**

Enamelled vessels for chemical reactions and connecting pieces therefor. Kobanyai Zomancarugyar. **807 369**

Betaine ascorbate and its production. Soc. Des Usines Chimiques Rhone-Poulenc. **807 418**

Haloaryloxyalkyl esters of α, α-dichlorobutyric acid. Dow Chemical Co. **807 327**

Aqueous dispersions of polychloroprenes and process of making them. Du Pont de Nemours & Co., E. I. **807 496**

Parasiticide composition containing 2, 6-dicyclohexyl-p-cresol. Dow Chemical Co. **807 328**

Device for simultaneously cleansing the outlets for dust and clean gas in cyclones. Svenska Flaktfabriken A. B. **807 329**

Safety valve venting system for a chemical process. American Cyanamid Co. **807 399**

Polytrifluorochloroethylene plastic. Miller, W. T. [Divided out of 807 431.] **807 432**

Method for stabilising textile fibres and compositions thereby obtained. Dow Chemical Co. [Divided out of 807 455.] **807 456**

Method of producing olefinic compounds. Institut Francais du Petrole, Des Carburants et Lubrifiants. [Divided out of 807 501.] **807 502**

Surface-modified silica products and silicone rubbers containing same. Monsanto Chemical Co. [Divided out of and addition to 807 452.] **807 454**

Open to public inspection 21 January 1959

Fuel elements for nuclear reactors. U.K. Atomic Energy Authority. **807 751**

Manufacture of phenolic resins. Walker Extract & Chemical Co. Ltd. [Cognate application 20619.] **807 851**

Surface treatment of metals. Walterisation Co. Ltd. [Cognate application 4286.] **807 878**

Apparatus for the treatment of air inside an enclosed space. Tucker, F. N. **807 612**

Filters for liquids. Manlove, Alliott & Co., Ltd. **807 783**

Process and apparatus for the treatment of hydrocarbons. Hydrocarbon Research Inc. **807 713**

Production of electrolytic copper coatings. Dehydag Deutsche Hydrierwerke G.m.b.H. **807 574**

Tertiary amines and their salts and process for their preparation. Thomae G.m.b.H. Dr. K. [Divided out of 802 723.] **807 837**

Polymer hydrosols and coating compositions containing them, particularly for photography. [Addition to 796 401.] **807 891**

Trisazo-dyestuffs containing an ortho: ortho'-dioxy-azo grouping and complex metal compounds thereof and processes for their manufacture. Ciba Ltd. **807 575**

Polymeric materials and coating compositions containing them, particularly for photography. Kodak, Ltd. [Addition to 796 401.] **807 894**

Carboxyalkylcellulose ethers and method of manufacturing same. Wyandotte Chemicals Corp. **807 576**

Manufacture of basic carboxylic esters. Farbwerke Hoechst AG. **807 757**

Preparation of benzene dicarboxylic acids. Mid. Century Corp. **807 650**

Plasma fraction and standard plasma preparation and method of preparing same. Ortho Pharmaceutical Corp. **807 781**

Thromboplastin and thromboplastic compositions and method of preparation thereof. Ortho Pharmaceutical Corp. **807 782**

Adhesives or cements and a process for the production thereof. Albrecht, P., and Pelikan, F. **807 855**

Reinforcing fillers for rubbery materials and rubbery compositions containing same. Goodrich Co., B. F. **807 911**

Coating compositions. Du Pont de Nemours & Co., E. I. **807 895**

Lacquer-coated metal surfaces. Du Pont de Nemours & Co., E. I. **807 912**

Coating of metal surfaces. Du Pont de Nemours & Co., E. I. **807 913**

Catalytic treatment of sulphur-contaminated hydrocarbons. Hercules Powder Co. **807 786**

Method of concentrating potash ores. International Minerals & Chemical Corp. **807 715**

Process and solution for the production of waterproof coatings or adhesives. Henkel & Cie. G.m.b.H. **807 761**

Distillation apparatus. Smith, A. F. **807 857**

Products having ambergris aroma and a process of making same. Dragoco Spezialfabrik Konz. Reich- und Aromastoffe Gerberding & Co. G.m.b.H. **807 616**

Steroid compounds of the pregnane and androstane series and their preparation. Abilgaard, K. [trading as Lovens Kemiske Fabrik ved A. Kongsted]. **807 578**

Production of spiro heterocyclic phosphorus-containing compounds. Union Carbide Corp. **807 896**

Production of xylenes. British Petroleum Co., Ltd. Northcott, R. P., and Cuddington, K. S. **807 717**

Refractory products. Manufactures des Glases et Produits Chimiques de St.-Gobain, Chauny & Cirey S.A. des. **807 765**

Wood stains containing azo dyes. Chadeloid Corporation. **807 822**

Protective coatings. Libbey-Owens-Ford Glass Co. **807 789**

Hydantoin derivatives. Imperial Chemical Industries, Ltd., Brimelow, H. C., and Vasey, C. H. **807 676**

Production of alkynols and alkynediols. Fairweather, H. G. C. (General Aniline & Film Corp.). **807 581**